UNITED STATES DEPARTMENT OF THE INTERIOR, Stewart L. Udall, *Secretary*

FISH AND WILDLIFE SERVICE, Clarence F. Pautzke, *Commissioner*

BUREAU OF COMMERCIAL FISHERIES, Donald L. McKernan, *Director*

POMPANOS (*TRACHINOTUS* SPP.) OF SOUTH ATLANTIC COAST OF THE UNITED STATES

BY HUGH M. FIELDS

FISHERY BULLETIN 207

From Fishery Bulletin of the Fish and Wildlife Service

VOLUME 62

PUBLISHED BY UNITED STATES FISH AND WILDLIFE SERVICE • WASHINGTON • 1962

PRINTED BY UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON, D.C.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. - Price 30 cents

Library of Congress catalog card for the series, Fishery Bulletin of the Fish and Wildlife Service:

U.S. *Fish and Wildlife Service.*
Fishery bulletin, v. 1–
Washington, U.S. Govt. Print. Off., 1881–19

v. in illus., maps (part fold.) 23–28 cm.

Some vols. issued in the congressional series as Senate or House documents.
Bulletins composing v. 47– also numbered 1–
Title varies: v. 1–49, Bulletin.
Vols. 1–49 issued by Bureau of Fisheries (called Fish Commission, v. 1–23)

1. Fisheries—U.S. 2. Fish-culture—U.S. I. Title.

SH11.A25 639.206173 9—35239*

Library of Congress [59r55b1]

CONTENTS

	Page
Introduction	189
Methods and definitions	189
Measurements	189
Enumerations	190
Growth and development	190
Drawings	190
Unidentified larval *Trachinotus*	191
Trachinotus spp. of south Atlantic coast	192
Trachinotus carolinus (Linnaeus)	192
Trachinotus falcatus (Linnaeus)	196
Trachinotus glaucus (Bloch)	201
Ontogeny of *Trachinotus* species	203
Head length	203
Eye diameter	203
Body depth	204
Dorsal fin	210
Anal fin	211
Pectoral fin	212
Pelvic fin	213
Caudal fin	213
Gill rakers	213
Preopercular spines	214
Branchiostegal rays	215
Dentition	215
Literature cited	216
Appendix	218

ABSTRACT

Three species of pompano, *Trachinotus carolinus* (Linnaeus), *T. falcatus* (Linnaeus), and *T. glaucus* (Bloch), are residents of the south Atlantic coast of the United States. *T. carolinus* is the most common species and the young are plentiful along the Georgia beaches during the warmer months. Beach recruitment is comprised of periodic waves of small individuals, the major influx appearing in April and May. Young *T. falcatus* are fairly common along the Georgia beaches during the warm season, appearing first in late May or early June; but recruitment is erratic, with only one wave, in September or October. Recruitment occurs almost all year long in southern Florida. Young *T. glaucus* are stragglers along the Georgia beaches, appearing infrequently in collections between August and November and at larger minimum sizes than *T. carolinus* and *T. falcatus*. Unidentified *Trachinotus*, 3.05 to 4.66 mm. standard length, were taken in offshore waters. The sizes and locations of capture of offshore specimens of *T. carolinus* and *T. falcatus* indicate spawning probably in or near the Gulf Stream. Great variation in color, body depth, and profile is found in *T. falcatus*. Young of the three species and the smaller unidentified specimens are figured; natural history observations are presented; and growth and development are discussed. Additional reasons are given for considering *T. argenteus* (Cuvier) to be synonymous with *T. carolinus*, and *T. goodei* Jordan and Evermann synonymous with *T. glaucus*.

OMPANOS (*TRACHINOTUS* SPP.) OF SOUTH ATLANTIC COAST OF THE UNITED STATES

By HUGH M. FIELDS, *Fishery Research Biologist*

BUREAU OF COMMERCIAL FISHERIES

Three species of the carangid genus *Trachinotus* acépède (pompanos), namely, *Trachinotus caro-inus* (Linnaeus), *T. falcatus* (Linnaeus), and *T. aucus* (Bloch), are recognized as being indigenous the south Atlantic coast of the United States. is my purpose to present the results of a study the early development of the pompanos, cluding descriptions and illustrations of the ung, discussion of pigmentation, ontogeny and owth, seasonal occurrence of the young on the eorgia coast, and natural history notes.

The bulk of the *T. carolinus* and *T. falcatus* ma-rial used in this study was collected in conjunction th the biweekly seining program of the Bureau of ommercial Fisheries Biological Laboratory, runswick, Georgia. (This material is identified this paper by the abbreviation BLBG.) This ogram, initiated in 1953 and still in operation, nsists of periodic seining at selected sites with nall-mesh (¼-inch bar) seines, 30 to 70 feet in ngth. Three permanent sites are used—open ean beach (King and Prince, St. Simons Island), lt marsh (Jekyll Island Causeway, and previ-sly, Sapelo Marsh), and fresh-water river ltamaha River at the county landing). Supple-entary seining is done on the open beach at kyll Island and at East Beach on St. Simons and. These seine locations are in Glynn unty, Ga., except Sapelo Marsh which is in jacent McIntosh County, Ga. Water tempera-re and salinity data are recorded from these es. Most of the *Trachinotus* taken by seine are m the open ocean beach locations. Other shore specimens were collected in shrimp trawls the Brunswick area and by the Menhaden vestigations, Biological Laboratory, Beaufort, C., (MI). Offshore specimens were taken dur-g the South Atlantic Fishery Investigations' field operations with the Fish and Wildlife Service research vessel *Theodore N. Gill;* and during operations aboard the Service's exploratory fishing and gear research vessel *Combat*. *Gill* specimens were collected in plankton tows using standard half-meter silk nets, high-speed metal nets, and by small-mesh dipnets; and the *Combat* material was collected in tows using a standard meter larvae net.

Other specimens examined were lent by the following institutions and individuals:

University of Florida Collections (UF), through John D. Kilby; Charleston Museum (ChM), through E. Milby Burton; United States National Museum (USNM), through Leonard P. Schultz; Institute of Jamaica (Inst. Jam.), through David K. Caldwell; University of Georgia (UG), through Donald C. Scott; Department of Biology, College of Liberal Arts, Boston University (BU), through Robert H. Gibbs; and the personal collection of Mr. and Mrs. Craig Phillips (Phillips). Also examined were fish in the commercial catch at Melbourne and Grant, Fla., on the Indian River, through the courtesy of Floyd Carver and other Indian River fishermen. Appreciation is expressed to the Indian River fishermen and staff members of the Biological Laboratory, Brunswick, Ga., and others who assisted in various ways.

Collection data for all specimens examined are given in appendix table 1, page 210.

METHODS AND DEFINITIONS

Measurements

Measurements below about 15 mm. were made with a micrometer eyepiece and dissecting microscope. Larger measurements were made with dividers and millimeter rule, dial calipers, or measuring board. All measurements below 5 mm. were recorded to the nearest hundredth millimeter; those between 5 and 50 mm. to the nearest tenth; and those above 50 mm. to the nearest half-milli-

he author is presently Extension Wildlife Specialist, North Carolina e College, Raleigh, N.C.

pproved for publication, July 26, 1961. Fishery Bulletin 207.

meter. The following measurements were used in this study:

Standard length (S.L.).—The distance, parallel to the longitudinal axis of the body, from the tip of the snout to the distal end of the hypural bones.

Depth.—Shortest distance from insertion of last dorsal spine to insertion of first anal spine.

Head length.—Distance, parallel to longitudinal axis of the body, from tip of snout to posteriormost point of opercular flap.

Eye diameter.—Distance, parallel to longitudinal axis of the head, from anteriormost to posteriormost points of bony orbit.

Dorsal-lobe length.—Shortest distance between insertion of last dorsal spine and distalmost point of dorsal-fin lobe.

Anal-lobe length.—Shortest distance between insertion of third anal spine and distalmost point of anal-fin lobe.

Dorsal-base length.—Shortest distance between insertion of first dorsal spine and insertion of last dorsal soft-ray.

Anal-base length.—Shortest distance between insertion of first anal spine and insertion of last anal soft-ray.

Pectoral length.—Shortest distance between insertion of pectoral-fin spine and distalmost point of pectoral fin.

Pelvic length.—Shortest distance between insertion of pelvic-fin spine and distalmost point of pelvic fin.

Caudal lobe length.—Shortest distance from anteriormost secondary ray of upper caudal lobe to posteriormost point of upper caudal lobe.

Enumerations

Numerable characters used here are dorsal-, anal-, pectoral-, pelvic-, and caudal-fin formulae; gill-raker and preopercular-spine counts; branchiostegal-ray counts; and dentition.

Spines are represented by Roman numerals and soft rays by Arabic numerals. In small fish interspinous membranes are present between the dorsal spines and the anal spines as well as between the posteriormost spines and the anteriormost soft rays. As the fish grows, the interspinous membranes degenerate and the posteriormost spine becomes adnate to the soft fin. Therefore, the posteriormost spine in the dorsal and anal fins is considered part of the soft fin. A specimen bearing a dorsal complement of seven spines and 20 soft rays will have a dorsal formula written VI–I, 20 whether or not the spines are joined by membranes to each other or to the soft fin.

The development of principal caudal rays only is treated here.

Gill-raker counts were taken from the first gill arch. The formula consists of the number of rakers above the one at the angle of the arch plus the angle raker and those on the lower limb, i.e., a gill-raker formula of 7+13 signifies 7 rakers on the upper limb, 1 at the angle, and 12 on the lower limb of the first arch.

Branchiostegal rays, counted on both sides, are recorded left to right, i.e., 8+7 indicates eight rays in the left and seven in the right branchiostegal regions.

Specimens were examined for dentition on the premaxillaries, vomer, palatines, tongue, and dentaries.

All lengths of fish are standard lengths unless otherwise stated.

Growth and Development

In the discussion of growth and development, my findings are compared with those of Ginsburg (1952). The pectoral soft-ray enumerations do not agree with Ginsburg, as his ray counts indicate a minimum and maximum range of one more ray than I found. It is assumed that he included the pectoral spine in his counts, and as presented here the counts exclude the spine.

A soft-ray is considered branched when the cleft separates the distalmost segment into two distinct segments. The uppermost or anteriormost ray of the pectoral fin and the uppermost and lowermost principal rays of the caudal fin never branch. Branching is considered complete when all other rays in these fins have branched, ignoring the branching to the base of the posteriormost ray in the dorsal and anal fins. Branching presents no distinct pattern in the dorsal or anal fins other than that the fourth through last rays usually branch before the first three. The pectoral and pelvic fins branch progressively away from the spine. The median caudal rays branch first, followed by progressive branching of the other principal rays.

Development of body parts is presented as percent of standard length (% S.L.).

Drawings

Drawings were made with the aid of a dissecting microscope and camera lucida.

UNIDENTIFIED LARVAE *Trachinotus*

Six larvae less than 5 mm. long were taken yond the 100-fathom line during *Gill* and *Combat* erations. Three were so mutilated as to be of tle diagnostic use.

The illustrated specimens (figs. 1, 2, and 3) are signated *Trachinotus* primarily on the distinctive ape and arrangement of the preopercular spines and the ontogenetic connection with the development of these spines in slightly larger *Trachinotus*. The 4.66-mm. specimen may well be *T. carolinus*, considering the number of dorsal and anal fin ray buds present and the space left for more buds. The 3.07-mm. specimen resembles the 4.66-mm. larva and may also be *T. carolinus*. The 4.0-mm. larva is so distorted as to resist speculation on its specific identification.

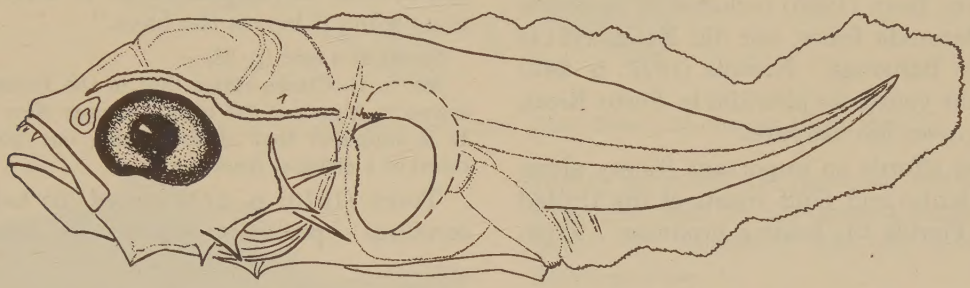

FIGURE 1.—*Trachinotus* sp., 3.07 mm. (*Gill* cruise 2, regular station 2).

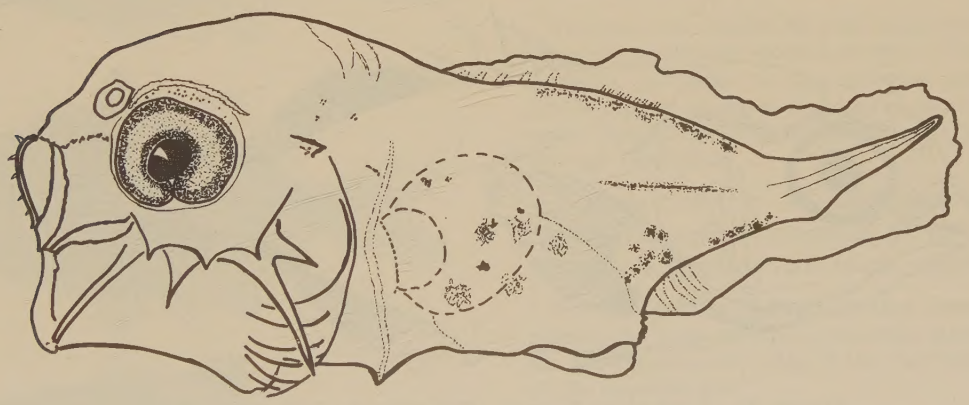

FIGURE 2.—*Trachinotus* sp., 4.0 mm. (*Combat* station 302).

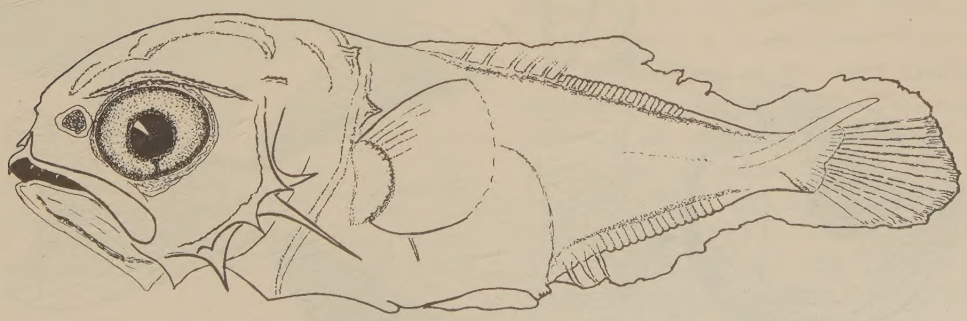

FIGURE 3.—*Trachinotus* sp., 4.66 mm. (*Combat* station 302).

TRACHINOTUS SPP. OF SOUTH ATLANTIC COAST

TRACHINOTUS CAROLINUS (LINNAEUS)

Trachinotus carolinus, (figs. 4–7), the common pompano, is apparently the most abundant species of the genus *Trachinotus* on the southeastern coast of the United States. Meek and Goss (1885: p. 128) stated that "On our South Atlantic and Gulf Coasts this is by far the most abundant species of the genus." Neither Beebe and Tee-Van (1933) nor Bean (1906) included *T. carolinus* among the Bermuda fishes, nor did Rosen (1911) list it for the Bahamas. Nichols (1929: p. 242) stated that the young are plentiful in Porto Rican waters, but grown fish are rare.

The species affords an important fishery along the south Atlantic and Gulf coasts of the United States, with Florida the leading producer. From 1955 through 1958 the total Florida catch was 2,425,247 pounds, valued at $1,748,993 (Anderson and Power, 1957; Bureau of Commercial Fisheries, 1959; Power, 1958 and 1959).

Spawning

There has been considerable speculation on the life history of *T. carolinus*, especially as to time and place of spawning. Goode (1882: p. 39) quoted Stearns, "In regard to its spawning habits nothing very definite has been learned. It has spawn half developed when it arrives and has none when it leaves the bays."

Goode also said (p. 38)—

Mr. S. C. Clarke states that in the Indian River they spawn in March in the open sea, near New Smyrna, Fla. It is supposed that those visiting our northern coasts breed at a distance from the shore.

Tracy (1910: p. 113) stated his belief that *T. carolinus* "probably spawn on east coast of

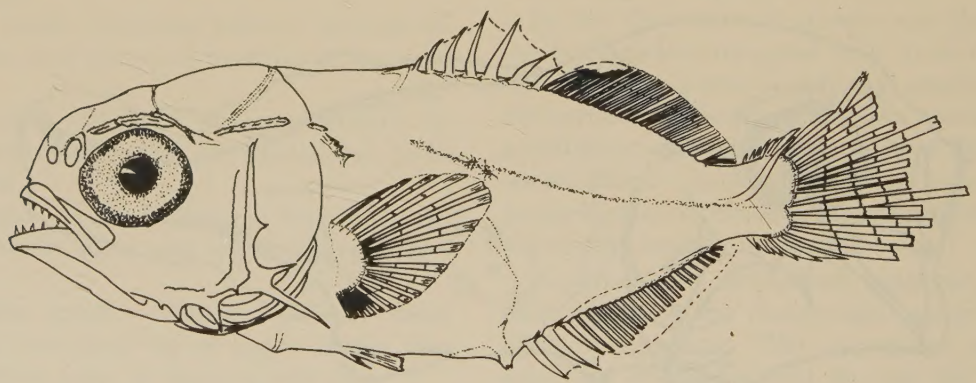

FIGURE 4.—*T. carolinus*, 7.2 mm. (*Gill* cruise 3, regular station 42).

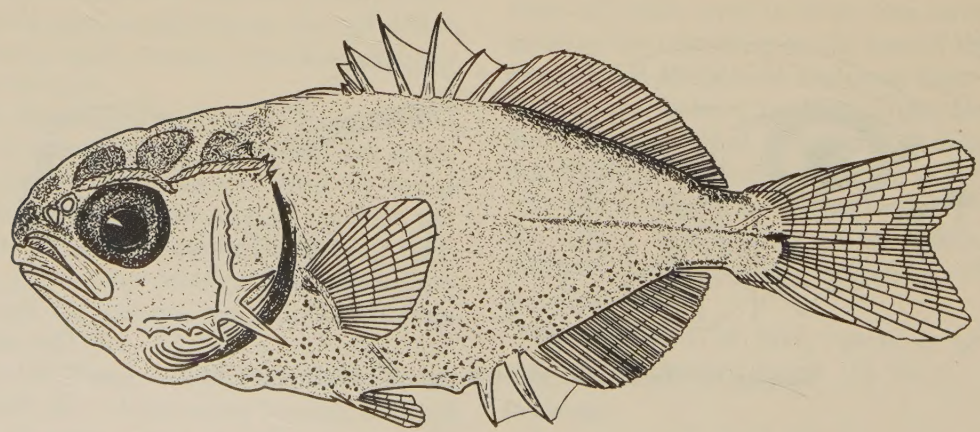

FIGURE 5.—*T. carolinus*, 11.0 mm. (*Gill* cruise 8, regular station 47).

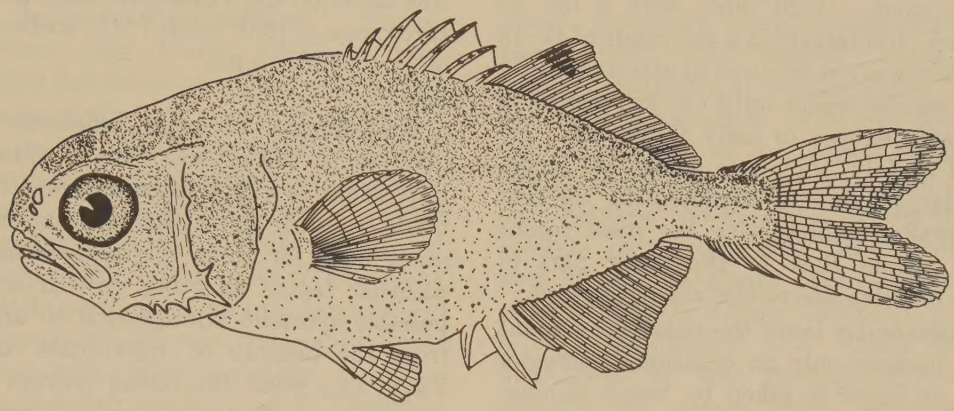

FIGURE 6.—*T. carolinus*, 14.8 mm. (East Beach, St. Simons Island, Ga.).

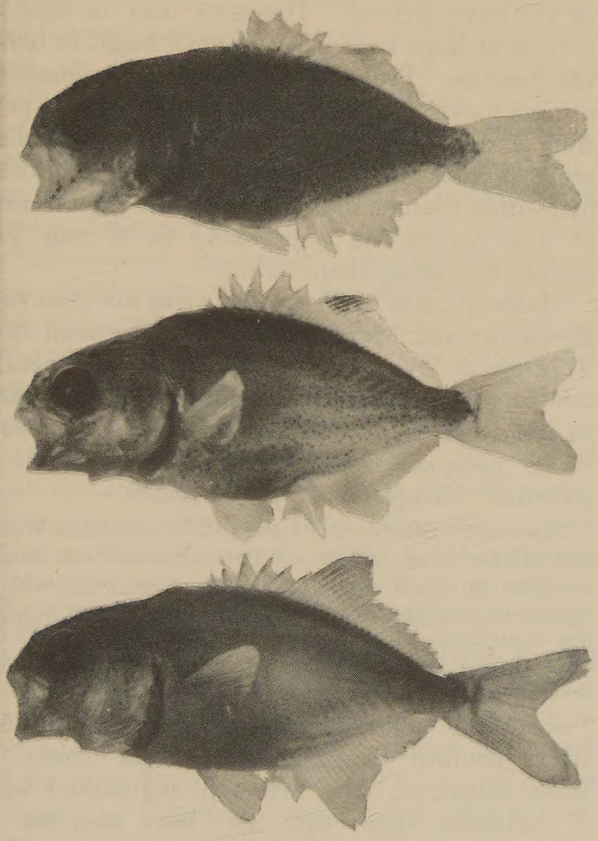

FIGURE 7.—*T. carolinus*. Upper, 18.9 mm. (King and Prince Beach, St. Simons Island, Ga.). Middle, 27.2 mm. (East Beach, St. Simons Island, Ga.). Lower, 42.1 mm. (King and Prince Beach, St. Simons Island, Ga.).

Florida in April and May. Full of nearly ripe spawn in April on the coast of Florida. . . ." Billy Christisen, an employee of one of the fish companies in Melbourne, Fla., on the Indian River, informed me (personal conversation) that over the years he has dressed hundreds of "pompano" (*T. carolinus*) and has never found any developed roe.

Springer and Pirson (1958: p. 177) speculated on the breeding season on the Texas coast—

> Pompano are caught all year long, but major catches occur during March, April, and May. These months are probably just prior to the breeding period as Gunter (1945) reports young as small as 13 mm. from June, and states that fish as small as 23 mm. were taken from June through December.

Nichols (1934: p. 46), referring to the lack of certain carangids (including *T. carolinus* and *T. falcatus*) in the Bermuda fauna, stated that—

> The probable explanation is that there are spawning grounds for these species in southern latitudes in or near the left (continental) edge of the Gulf Stream, and none on the opposite side.

The collection of two small specimens of this species in offshore waters indicates that *T. carolinus* spawns in the open ocean, either in the Gulf Stream or in locations where the transport and distribution of the eggs and larvae are influenced by this current. Two small specimens collected in offshore waters, were examined in this study. The first, 7.2 mm. (fig. 4), was taken near the 100-fathom line on *Gill* cruise 3, regular station 42 (31°57′ N., 79°16′ W), August 5, 1953. The other, 11.0 mm. (fig. 5) was taken on *Gill* cruise 8, regular station 47 (32°40′ N., 79°00′ W), September 25, 1954.

Recruitment

Young *Trachinotus carolinus* first appear on the Georgia beaches during the last half of April or

631439 O—62——2

the first half of May. This recruitment consists of small specimens, 11–20 mm., with a few as large as 30 mm., but largely in a size range of 13–18 mm. This first wave is followed at about monthly intervals by similar waves until the fish leave the beaches in late October to early December. By the first half of July, three size modes are recognizable; the largest (in size) representing the first wave, the smallest representing the most recent recruitment. From then to the latter part of October two or three size modes are recognized.

The fish apparently leave the beaches at about 60–70 mm., because only an occasional straggler of that size or larger is taken by beach seining. Therefore, fish apparently from the first wave leave the beach in the latter half of July, followed by the second wave in August, et cetera.

Analysis of seine collections of the Biological Laboratory at Brunswick, Ga., for the years 1956, 1957, and 1959 indicated that initial recruitment may represent the major spawning because the numbers of individuals collected during April and May for each year comprise about 56–66 percent of the total number of individuals taken in each year.

Recruitment continues into late October to early December, at which time 13.6- to about 50-mm. specimens are found on the beach, with an occasional larger straggler.

Water temperatures follow a consistent annual cycle on the open beaches in the Brunswick, Ga., area, especially during the warmer months. For the years 1956–59, the average monthly water temperatures (° C.), based on biweekly records from King and Prince and East Beaches, were for April, 21°; May, 26.6°; June, 27.8°; July, 30.5°; August, 30.3°; September, 28.6°; October, 24.2°; and November, 19.0°. The highest temperature recorded for this period is 33.0°.

Salinity of the beach water during the period 1956–59 was very erratic, with variations as high as 8.39 parts per thousand occurring in the same month and with 17.07 p.p.t. and 36.65 p.p.t. the extreme readings for April through November.

Based on the data for the years 1956–59, *T. carolinus* first appears on the Georgia beaches when the water temperature rises to about 19° C., leaves in the fall when the water cools to about the same temperature, and has been taken at both salinity extremes (17.07–36.65 p.p.t.).

Gunter (1945: p. 59) stated that *T. carolinus* was taken on the Texas gulf beaches in a temperature range of 19.0° to 30.7° C., and a salinity range of 28.1 to 36.7 p.p.t.

Size

Examination of seine collection data reveals little as to the growth rate of these fish. It is impossible to tell if consecutive collections were made from the same local population of a recruitment wave or from migrants along the shore. Another factor affecting growth analysis is the possible sporadic immigration to and emigration from the beaches of individuals comprising the wave; i.e., when the initial portion of a wave is sampled as it first reaches the beach, many individuals, especially of the smaller sizes, may not as yet have arrived. The same may be true in reverse at large sizes when the fish begin to leave the beaches. Probably the larger individuals in a wave move out first, and the emigration is possibly a random movement. Efforts to establish growth rates from existing samples produced little other than an indication that the growth rate of these young fish is probably 14–30 mm. per month, averaging about 22 mm.

Maximum size of *T. carolinus* was not resolved. Evermann and Marsh (1902: p. 140) stated that *T. carolinus* "reaches a maximum length of nearly 2 feet and a weight of 6 or 8 pounds." According to Hildebrand and Schroeder (1928: p. 231), "This pompano reaches a weight of about 5 pounds." Gregg (1902: p. 55) stated—

> The market fishermen of Indian River and Lake Worth *do* think the "true" or Common Pompano have been caught weighing up to 27 pounds. I have often been told of specimens weighing 20 to 25 pounds. I am quite sure the one caught by Capt. Gardner at Lake Worth April 15, 1898, was a true Pompano, as he was compared with several undoubted Pompanos . . . .

Present-day market fishermen on the Indian River confirm Gregg's observations. Some of these fishermen, who are well acquainted with *T. carolinus*, assert that they have seen fish in the 30-pound class that they identify as large "pompano." The Indian River fishermen differentiate between *T. carolinus* and *T. falcatus* by the colloquial name "pompano" for the former and "permit" for the latter. *T. glaucus* is unknown to them as an inhabitant of Indian River.

Food

The food habits of *T. carolinus* are well known. Goode (1882: p. 38) stated that "their food con-

ts of mullusks, the softer kinds of crustaceans, d probably, the young of other fishes." Accord- g to Evermann and Marsh (1902: p. 140), The food of this fish seems to consist very largely small bivalve shells and small crustaceans." racy (1910: p. 113) listed "Stomach contents: hes, small crustacea, amphipods, lamellibranch ells, diatoms, and vegetable debris. Often en rooting or digging in the sand for food . . . ." unter (1958: p. 189), referring to *T. carolinus*, ated "The little pompano feed to a large extent young *Harengula*, and are commonly found the summer with their stomachs distended ith them." Stomach contents of *T. carolinus*, 3.5–80.5 mm. from the Georgia beaches, were und to contain amphipods, bivalve mollusks, ab larvae, copepods, isopods, and invertebrate gs, in that order. Also found were small ssile barnacles, polychaetes, cumacea, unidenti- ed small crustacea, and other invertebrates. nd was quite commonly found in the stomachs, nfirming Tracy's observations. Indian River arket fishermen state that it is not uncommon see several "pompano" accompanying large ys, particularly the spotted eagle ray, as they ed, supposedly feeding on mollusks and crustacea ncovered by the rays and also on morsels the ys fail to ingest.

olor

Meek and Hildebrand (1925: p. 385) stated at the color of *T. carolinus* is "bluish above, lvery below; ventrals pale; other fins usually lack or dusky." Smith (1907: p. 214) gave the olor as "bluish or greenish on back, silvery on des, rich golden yellow below; fins with bluish yellowish shades." Ginsburg (1952: p. 80) ated that coloration is "Silvery, with a grayish nge on upper half, lighter below; fins dusky in ne larger specimens, usually almost uniformly ; no cross bands." Bean (1903: p. 444) gave ne color as "Uniform bluish above, sides silvery, olden in the adult, without bands, fins plain lvery or dusky."

Beach specimens (20–40 mm.) freshly killed in rmalin exhibited the following coloration:

Chin, branchiostegal region, and ventral surface f body anterior to pelvic base white. Belly and wer sides of body from pectorals to caudal base lvery-white flecked with plumbeous chromato- hores. Dorsal surface and upper sides of head nd body metallic blue-green. Spinous dorsal with hyaline interspinous membranes; spines dusky, especially along leading edges. Anterior part of soft dorsal virtually black, because of the concentration of melanophores between first six or seven soft-rays. The lobe is dusky to the tip. Remainder of soft dorsal hyaline along its distal margin and proximal third of fin; base and area between hyaline parts lightly dusky. Interspinous membranes and basal portion of soft anal fin hyaline; spines, leading edge of soft anal, lobe, and distal margin distinctly yellow. Scattered melanophores form dusky lines between first three or four pectoral soft-rays; rest of pectoral fin yellow along proximal half and hyaline toward tip. Pelvic fins bright yellow-white. Lobes of caudal fin bright yellow, flecked with melanophores, causing outer principal rays to appear dusky. Coloration diminishes toward inner rays. Upper secondary caudal rays dusky and lower ones hyaline. Eye with black pupil and silvery iris with lightly dusky patch above and below the pupil.

Live *T. carolinus* kept in aquariums exhibited limited ability to change color. Small specimens (15–30 mm.) were able to change body pigmentation from silvery to very dusky, with an intermediate "peppered" stage. Individuals above about 30 mm. constantly maintained a uniform silvery body color. Generally, live specimens in the 30–50-mm. range showed very little duskiness on the body and fins, except for the leading edge and lobe of the dorsal fin, which is opposed to the duskiness on the fins and bodies of preserved specimens (fig. 7).

Parasites

Linton (1905: p. 330–335, 366) listed the following organisms found to be parasitic on *T. carolinus:*

Protozoa: *Myxobolis* (*Henneguya*) sp.; Nematoda: Immature nematodes (*Ascaris*) usually encysted in viscera. Cestoda: *Rhynchobothrium* sp. (encysted) in mesentary and on viscera; *Scolex polymorphus* Rudolphi. Trematoda: *Aspidogaster ringens* Linton; *Distomum monticellii* Linton; *Distomum pectinatum* Linton; *Distomum valde-inflatum* Stossich; *Distomum vitellosum* Linton; *Distomum* sp.; and *Monostomum* sp.

The soft fins of small specimens of *Trachinotus* spp. are often deformed or atrophied by cysts that adhere to the rays. Mild infestations seem to cause little damage, but concentrated infestations

destroy parts of the rays and other parts of the fins.

Status of *Trachinotus argenteus*

Ginsburg (1952: p. 82) considered *Trachinotus argenteus* Cuvier synonymous with *T. carolinus*, and I agree.

The original description, translated by DeKay (1842: p. 116), is as follows:

The Silvery Trachinote

Trachinotus argenteus

Characteristics. Silvery. Height to its length as one to two. 5–6 dorsal spines, and one recumbent, directed forwards. Length six inches.

Description. Body elevated; its height being one-half the head and body alone, without including the lobes of the tail, which are more than one-fourth the total length. Lateral line irregular, with five or six slight undulations. Five and sometimes six free spines on the back, without including the recumbent spine in front, nor that which adheres to the dorsal. The rays of the dorsal and anal exceed in number most of their congeners. The points of the dorsal and anal, when lying supine, reach only half the length of these fins. The limb of the preopercle with slightly elevated radiating lines, and oblique striae on the base of the opercle. Teeth minute, equal and velvet-like. Vertebrae compressed, twenty-three. The recumbent spine is a part of the third interspinous.

Color. Silvery, with blackish at the elongated tips of the dorsal, and on the middle of the pectoral.

Length, 6.0.

Fin rays, D.5 or 6 . 1 . 24; P . 18; V. 1 . 5; A . 2 . 1 . 21; C . 17 8/8.

Jordan (1887: p. 531), referring to the type, stated that "It may stand as *Trachinotus carolinus.*"

Various authors differentiate between *T. carolinus* and *T. argenteus* on the basis of depth, with *T. argenteus* having a depth of 2 into standard length and *T. carolinus* a depth of about 2⅓ to 2⅔ into standard length. Bean (1903: p. 443) stated—

There is still some question whether or not the *argenteus* of Cuvier and Valenciennes is the young of *T. carolinus* (Linnaeus). If we consider them identical we must assume that the very young, say from 1 inch to 2 inches long, are much more elongate than when they reach the length of 3 inches.

Ginsburg (1952: p. 81, table XV; p. 82) has shown that *T. carolinus* with depths greater than 50% S.L. are found in a size range of about 66–274 mm. My findings coincide with his except that my depth percentages are slightly less. This is no doubt because of a difference in method of measurement. One 182-mm. specimen examined in this study has a depth 55% S.L. It is identical to the typical *T. carolinus* in every respect but depth.

TRACHINOTUS FALCATUS (LINNAEUS)

Trachinotus falcatus, the round pompano (figs. 8–13), is a widely distributed and fairly common species. The Florida fishery produced a total of 98,503 pounds of "permit," presumably this species, during 1955–58, valued at about $10,288 (Anderson and Power, 1957; Bureau of Commercial Fisheries, 1959; Power, 1958 and 1959).

Knowledge of the life history of *T. falcatus* is meager. Since the species is generally not so plentiful nor as commercially important as *T. carolinus*, it seemingly has failed to attract comparable attention.

Spawning

Four offshore specimens identified as this species were taken during the operations of the

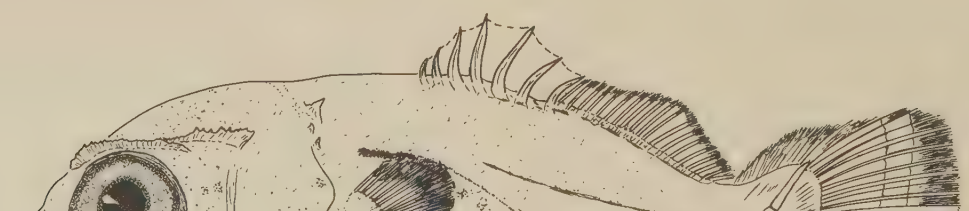

FIGURE 8.—*T. falcatus*, 5.0 mm. (*Gill* cruise 3, regular station 63).

FIGURE 9.—*T. falcatus*, 7.7 mm. (*Gill* cruise 2, regular station 40).

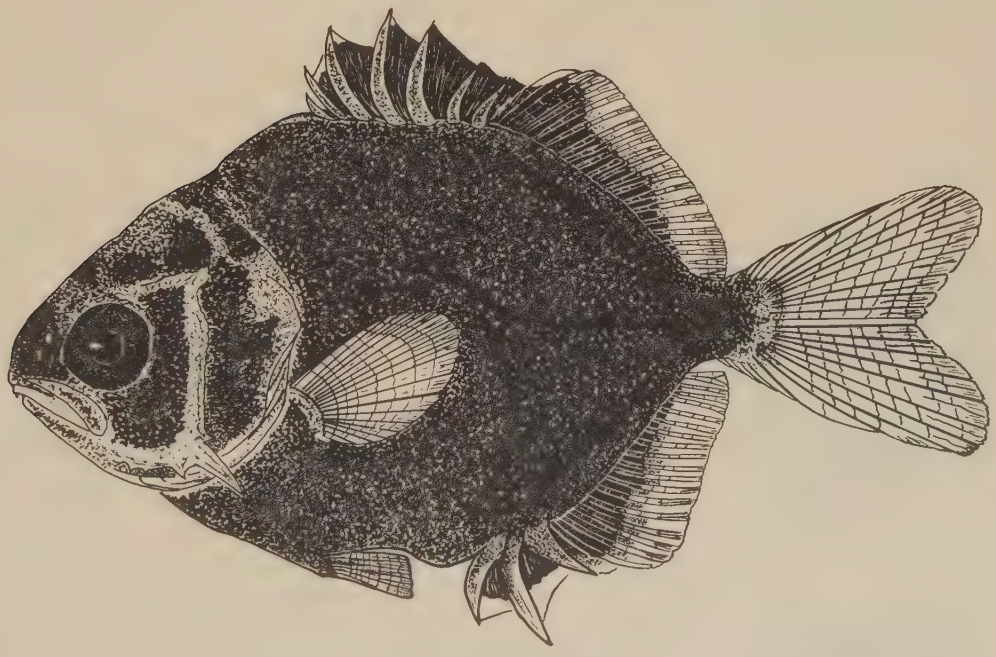

FIGURE 10.—*T. falcatus*, 16.9 mm. (King and Prince Beach, St. Simons Island, Ga.).

Gill (figs. 8 and 9), of which three were taken in close proximity to the axis of the Gulf Stream and one was taken at about the 100-fathom line. A fifth specimen (11.7 mm.), dip-netted aboard the M/V *Delaware*, was taken at 37°30′ N., 68°10′ W., about 360 miles east of Cape Charles, Va. The location of capture of these fish indicates offshore spawning habits for the species, in close proximity to or in the Gulf Stream.

Recruitment

T. falcatus arrives on Georgia beaches in late May or early June at a size range of 18 to 44 mm. From shortly after initial beach recruitment until the end of August it is never as abundant as *T. carolinus*, nor is there any apparent "wave." The beach population consists of scattered 14- to 66-mm. individuals. Between the first of September to the middle of October a major influx of

631439 O—62——3

FIGURE 11.—*T. falcatus*. Upper, 23.6 mm. (Capers Inlet, S.C., ChM 31.207.12). Lower, 26.2 mm. (Fort Pierce, Fla., Phillips collection).

FIGURE 12.—*T. falcatus*. Upper, 35.3 mm. (Capers Inlet, S.C., ChM 31.207.12). Lower, 35.5 mm. (Fort Pierce, Fla., Phillips collection).

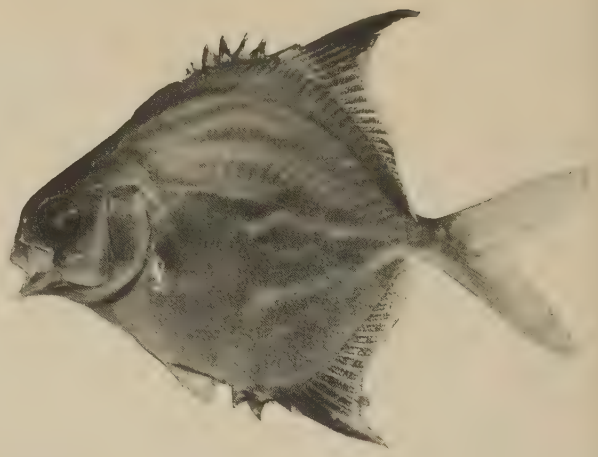

FIGURE 13.—*T. falcatus*. 59.5 mm. (Little River, 1 mile northeast of Calabash, N.C.).

small, 12- to 40-mm. fish appears on the beaches, supplementing the scattered population of larger fish. One to three size modes may be present at this time. Its stay is very short, for by latter October only a few individuals remain, these in the 14- to 65-mm. size range, and none is found after the middle of November.

Examination of material from southern Florida reveals a much different recruitment pattern than that found on the Georgia coast (See Phillips Collection, appendix table 1). In the Miami-Vero Beach area, specimens were taken throughout the year and generally at much smaller sizes than in Georgia. Specimens less than 12 mm. long were taken from January into September. The nearness of the Gulf Stream to the southern Florida coast no doubt influences the long period of beach recruitment and the small size of the inshore specimens. This pattern indicates a prolonged spawning season, much of which is restricted to subtropical waters.

Based on water temperature and salinity data for the years 1956–59 (see under *T. carolinus*, p. 194), *T. falcatus* first appears on Georgia beaches when the water is warmed to about 27° C., and remains on the beaches until the water cools to about 19.5°, and has been taken in a salinity range of 17.07–35.34 parts per thousand.

Size

Beebe and Tee-Van (1928: p. 116) stated that *T. falcatus* "Grows to 12 inches and a weight of 3 pounds." Breder (1948: p. 139) said that it reaches a length of about 18 inches. Ginsburg (1952) examined a specimen 790 mm. (about 31

h.) long. The maximum size attained by this pecies was not determined.

ood

Stomachs of Georgia beach specimens (15.1–3 mm.) contained isopods, amphipods, sessile arnacles, calanoid copepods, crab larvae, bivalve ollusks, flatworms, stomatopods, unidentified rustacea, and diptera (pupae and adults).

orm and Color

Marked variations in form and color of small *T. falcatus* have been noted by various authors. Mrs. Craig Phillips (personal communication) bserved—

The several dozen specimens I have seen . . . from the t. Simons (Georgia) area differ in several respects from he form most common in south Florida . . . The fish (from t. Simons) are almost invariably dark, reddish brown hen netted. They are quite robust with an impressive epth, and dorsal and ventral profiles that are quite angu-ar. This form is present south at least as far as the pper Keys. However the form that I have found to be ost common from Ft. Pierce (Florida) southward is nvariably silver when netted except . . . individuals less bout 20 mm., and these become gradually darker in pig-ent as their size decreases. This form appears to be ore slender with less angular dorsal and anal profiles. . . .

Breder made the following observations regard-ng *T. falcatus*:

Three examples about 24 mm. in standard length . . . were a smooth velvety black and the fins were hyaline. Two of these were kept in the Aquarium for a few weeks nd lost this pigmentation becoming a silvery color similar o the young of *T. carolinus*. The iris in life was a deep uby red (1923: p.3).

A single example of 24 mm. was taken. . . . Body eddish black with silvery reflections. Iris silver. Dorsal nd anal spines red, membranes of soft dorsal and nal dusky. Pectorals and ventrals hyaline, the latter dged anteriorly with deep orange (1926: p. 125).

These were about 20 to 30 mm. in length (without tail) nd were passing out of the dark phase. The red of the ris was completely gone and the coloration was nearly s silvery as that of *T. carolinus*, with just a faint dusky uggestion (1928: p. 6–7).

Beebe and Tee-Van (1928: p. 116) noted that—

Great variation exists among the small specimens taken n Haiti, and the variations change while the fish is being vatched. Some of these small fishes instead of being ilvery, have parts of the sides a warm brown, usually nsymmetrically. Descriptions from life . . . are given elow:

13 mm. Entire body thickly covered with small brown pots, so close together that the paler ground color is lmost obliterated; the brown color absent on the maxillary remaxillary and on the branchiostegal membranes. Top of head brick-red. Membrane of the spinous dorsal and base of the anterior membranes of the soft dorsal black, the black on the soft dorsal becoming less as it progresses backward. A few black dots on the dorsal spines. Base of the anal, membranes between the anal spines and the anterior membranes of the anal fin black. All other fins pale.

15 mm. Two specimens of this length were recorded as being iridescent bronze throughout; the iris and thickened web about the dorsal and anal spines grenadine red; the web between these spines and the basal half of the dorsal and anal rays black.

45 mm. Bluish silvery, with minute blackish punctulations over the entire body with the exception of the lower chin, isthmus and just before the ventrals. Dorsal membranes dusky. Anal membranes dusky basally, the duskiness decreasing posteriorly. Pectorals clear. Tips of the ventrals, the anal spines and tip of the anal lobe orange-red.

Gunter (1958: p. 190) was seemingly confused by the color variation. He stated—

Another species, at a size of 23 mm., was dusky or blackish, had reddish orange dorsal spines and a reddish orange eye. It seemed to be *T. falcatus*. . . . A third species, at a size of 23 mm., was reddish orange on the lower caudal lobe, the anal fin edge and large spine. It was called *T. goodei*, which Ginsburg synonymizes with *T. glaucus*, and probably belonged to the latter species.

Color notes of live and preserved specimens, made during my study, corroborate these observations. A 9.8-mm. specimen (preserved) from Fort Pierce, Fla., has the following color characters:

Body above midline and behind pectoral base brown. Large deep melanophores on sides of abdomen. Area behind abdomen and below midline with small scattered brown chromatophores and melanophores on flesh-colored background. Large deep melanophores and brown chromatophores along dorsal base, anal base and posterior part of midline, extending onto caudal peduncle, giving the effect of dim lines running along these areas. Spinous dorsal and spinous anal area dark brown. Other fins hyaline.

Three specimens (59–61 mm.) had these color characters when fresh:

Chin, isthmus, gill covers, area below eye and body below lateral line silvery-white (on one fish, light orange on a white background shows on lower limb of preopercle, mandibular articulation, chest and anal region). Body above lateral line and dorsal half of head light metallic. Dorsal spines and membranes between spines plumbeous; soft dorsal dusky, especially on lobe. Anal spines

and soft-fin lobe very bright orange; outer margin of soft anal hyaline, remainder dusky. Pectorals dusky at base, hyaline elsewhere. Pelvics with white background interspersed with very bright orange. Caudal with orange-yellow on most of lobes; outer rays dusky almost to tips; inner rays grading to hyaline. One 39.5-mm. specimen had much the same coloration except that it was duskier and the orange was more intense. My notes on a 64-mm. fresh specimen indicate similar coloration and give eye color as "pupil blue-black; iris coppery."

A single specimen, 17.6 mm., was kept in an aquarium and observed over a period of time. The following notes pertain to this specimen:

(1) June 5, 1958, at 1130 hours. Body silvery with slightly pinkish tinge on dorsal aspect. Spinous dorsal and soft fin lobe black; remainder with melanophores forming dusky lines between rays and along base. Spinous anal and soft fin lobe orange-red; remainder hyaline. Pectorals, pelvics, and caudal hyaline. Eye with pink-orange iris. At 1144 hours, body and fin color remained much the same, but iris was silvery.

(2) Undated, but between June 5 and June 9, 1958. Fish in aquarium—color as described June 5, 1958 at 1130 hours. Fish removed from aquarium and placed in beaker (of sea water); agitated by microscope light, and confinement. Posterior half of body turned dusky gray. Fish carried (outdoors) into direct sunlight—turned silvery. Returned indoors. Posterior half turned brown, then brownish color migrated to behind pectorals. When color began receding rearward, fish was agitated. Brown pigment covered entire body and head. Insertion of black or white background (into beaker) seemed to cause little immediate change in coloration. However, when left against white background for about 20 minutes, the top of head and back in front of spinous dorsal became a blotched flesh color. Fish returned to aquarium. After about 10 minutes, the coloration was silvery, as first described.

Subsequent tests with the same fish yielded similar results. Usually when the fish was disturbed the posterior half of the body turned uniformly dark brown first and then the color migrated anteriorly. The intensity of color change and the time involved varied considerably. The fish also showed some color changes when undisturbed in the aquarium. Usually these changes involved duskiness or blackness on areas of the body and on the dorsal lobe.

Variations in body depth in *T. falcatus* are considerable and exhibit no distinct relation to geographical location or time of year. Generally, fish taken at the same time and location have comparable depths, but specimens taken at different times from the same location and from different locations have widely diverse depths. Figure 18 illustrates the depth differences, expressed as percent of standard length of fish taken at five locations along the south Atlantic coast. Two of these locations, King and Prince Beach, St. Simons Island, Ga., and Fort Pierce, Fla., are represented twice each.

Marked differences occur in coloration and dorsal and anal profiles in the depth extremes in *T. falcatus* (figs. 11 and 12), and a general correlation exists between these characters and depth; i.e., the deeper the fish, the darker the color and the more angular the profile. The shallow Fort Pierce specimens have silvery sides and very little pigmentation on the vertical fins. They are also definitely "popeyed," and have uniform dorsal and anal profiles. Deep-bodied specimens, such as the Capers Inlet, S.C. fish, have much dark pigmentation on the body and on the vertical fins. The eyes are "normal" and the dorsal profile is slightly concave on the head and strongly convex over the procumbent spines. Another break in dorsal profile sometimes occurs near the last dorsal spine. The ventral profile usually has a break at the third anal spine.

The greatest extreme in depth, color, and dorsal and anal profile was observed in a 59.5-mm. specimen from Little River, on the North Carolina–South Carolina border (fig. 13). As mentioned earlier, dark body coloration is usually restricted to smaller fish. This Little River fish, with a depth of 75.4% S.L., has a greatly accentuated profile, is very dark brown on the body, and possesses almost black vertical fins.

Beebe and Tee-Van (1928: p. 115) referring to *T. falcatus*, observed—

> Our fish differs from the photograph (Plate XXXIII) of a 48-mm. fish given by Meek and Hildebrand in that the depression over the eyes is not so marked. In all the specimens the profile from the nostrils to the dorsal fin is almost straight, with a slight convexity on the posterior part.

Meek and Hildebrand's (1925: Plate XXXIII,

facing p. 378) illustration of a 48-mm. *T. falcatus* obviously depicts a fish with abnormal development; i.e., clearly evident preopercular angle spines, very short dorsal and anal lobes, complete membrane connections between spines, and an exceptionally small caudal fin. The fish also has much dark coloration, and judging from the photograph the depth is about 73% S.L. This specimen and the fish from Little River may indicate a correlation between extreme body depth and abnormal rate of development.

Parasites

Linton (1940: p. 75–82, 156) listed the following organisms found to be parasitic on *T. falcatus*:

Trematoda: *Cymbephallus vitellosus* (Linton); *Cryptocotyle lingua* (Creplin) cysts on skin of body and fins.

TRACHINOTUS GLAUCUS (BLOCH)

Trachinotus glaucus, the palometa, (figs. 14–17), is comparatively rare along the south Atlantic coast. The main part of its range is farther

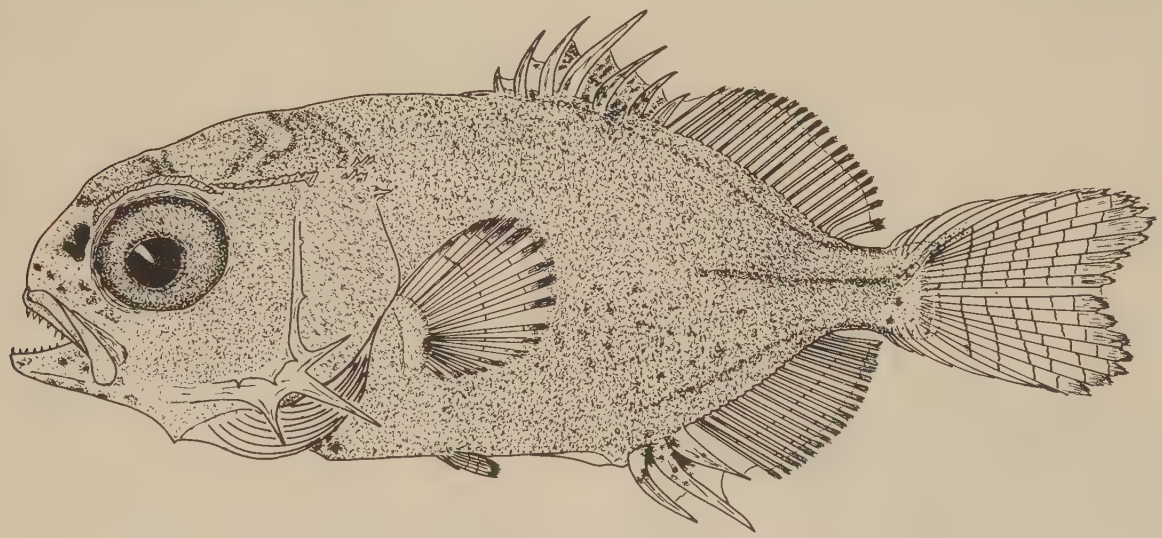

FIGURE 14.—*T. glaucus*, 7.8 mm. (Seaquarium boat dock, Miami, Fla., Phillips collection).

FIGURE 15.—*T. glaucus*, 11.8 mm. (Crandon Park, Miami, Fla. Phillips Collection).

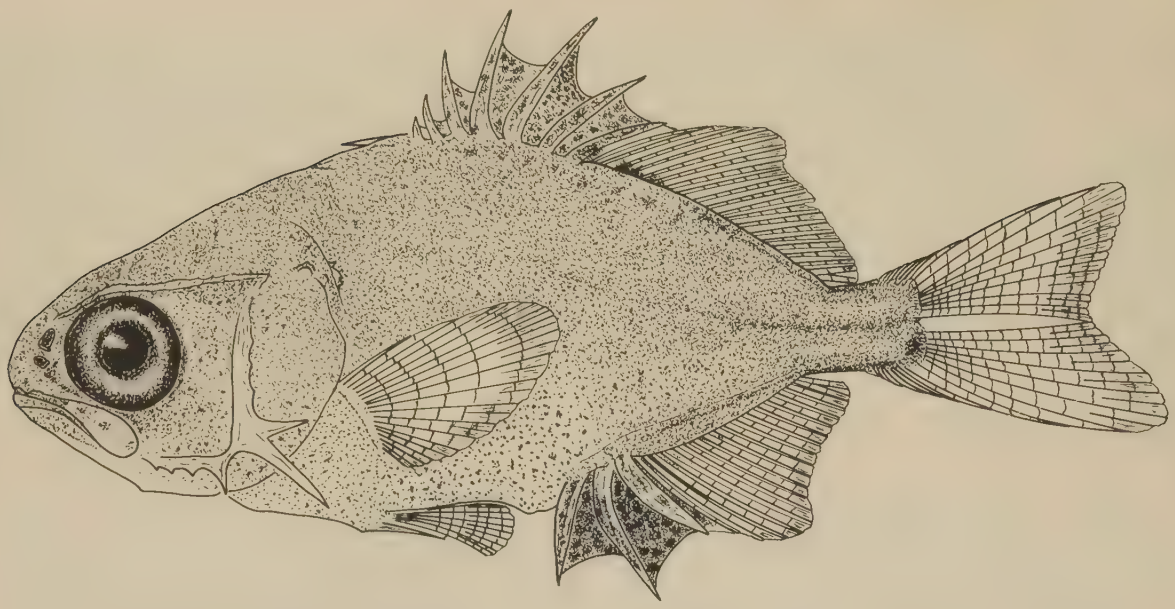

FIGURE 16.—*T. glaucus*, 14.6 mm. (Louisiana. USNM 143953).

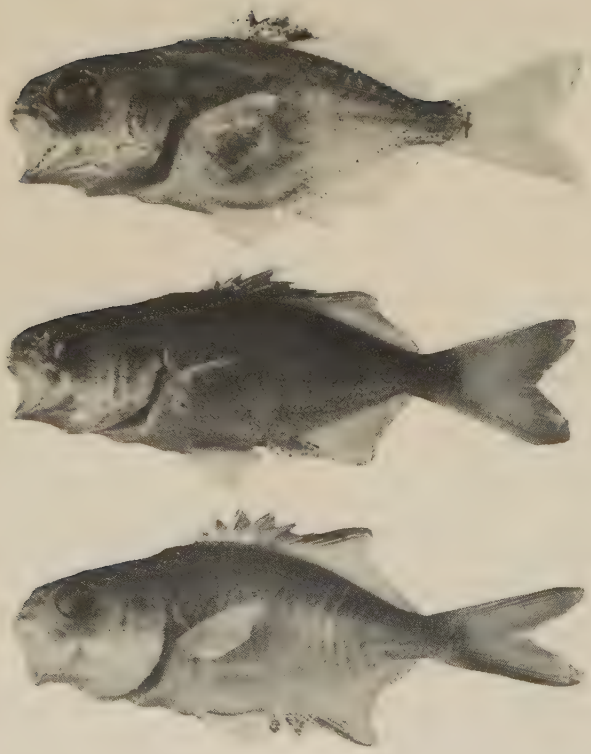

FIGURE 17.—*T. glaucus:* Upper, 19.4 mm. (King and Prince Beach, St. Simons Island, Ga.) Middle, 28.9 mm. (King and Prince Beach, St. Simons Island, Ga.) Lower, 39.4 mm. (King and Prince Beach, St. Simons Island, Ga.).

south, and it is apparently not so abundant anywhere on the mainland as the other species.

Virtually nothing has been published about its life history, and the few individuals taken during the seining program of the Biological Laboratory at Brunswick on the Georgia beaches do little to augment present knowledge. Twelve individuals, 19.4–61.0 mm., have been taken. All were collected from August to November.

Size and Food

As with the other species, the maximum size of *T. glaucus* is uncertain. Beebe and Tee-Van (1933: p. 108) said that it grows to about a foot. Carvalho (1941: p. 55) stated that its food consists of crustaceans and small fish. Examination of stomachs of the Laboratory specimens produced amphipods, bivalve mollusks, diptera, stomatopods, hymenoptera, crabs, fish, and isopods, in that order of significance.

Color and Form

Evermann and Marsh (1902: p. 138) gave coloration as—

> . . . bluish above, golden below; lobes of dorsal and anal very dark; rest of fins pale, with bluish edges; caudal bluish; pectorals golden and bluish; ventrals whitish. Body crossed by four black vertical bands, . . . a black spot representing a fifth band on lateral line between last rays of dorsal and anal, ...

My specimens larger than 70 mm. exhibited very little color. The upper half of the body and

head was dull blue-gray, grading into white in the branchiostegal region, breast, lower sides, and belly. Dorsal and anal lobes black, remainder of these fins dusky. Pectorals slightly dusky; pelvics white. Caudal lobes very dusky along outer rays; lighter toward inner rays. Five dark vertical bars along sides of body.

Specimens 40 mm. and smaller can easily be confused with *T. carolinus* because of the similarity in coloration and depth of body. Fresh specimens exhibit dull silvery dorsal surfaces and light gray to white flanks and belly. The dorsal lobe is black; the anal lobe cinnamon and black (black in preserved specimens). The spinous dorsal and anal are pigmented. Other fins are very slightly dusky, except for the caudal, which is moderately dusky along upper and lower margins. There are no bars on the body of the laboratory specimens. Evermann and Marsh (1902: p. 138), referring to small *T. glaucus*, observed—

> Young individuals, 2 inches in total length, may be described as follows: . . . Color, bright-silvery, merging into metallic-bluish on back and yellowish on lower sides and belly; the four dark vertical bars very faint, but usually distinguishable with a lens, . . . anterior rays of dorsal and anal and outer rays of caudal black.

They also stated that—

> Comparing young examples in our collection from Porto Rico with specimens of similar size from Woods Hole which have been identified as the young of *T. goodei*, it is found that they are difficult to distinguish. The general form, proportional measurements, fins, and general coloration are very much alike, but the black vertical bars are apparently not present on the Woods Hole specimens.

Status of *Trachinotus goodei* and "Permit"

Ginsburg (1952: p. 76) placed *T. goodei* Jordan and Evermann in the synonymy of *T. glaucus*, an action my observations substantiate.

Trachinotus goodei Jordan and Evermann (1896: p. 943) is "described from a small specimen from Key West, the characters of the adult taken from Günther." Morphometric and numerable characters given in the description well fit a small *T. glaucus* of about 30–50 mm.: "Head 3; depth 2⅔. D. VI–I, 19; A. II–I, 17," and ventrals 2 in head; anterior soft-rays of dorsal and anal fins (dorsal and anal lobes) 4 in length of body, in the young; caudal lobes about 3 in body.

Examination of photographs of syntypes (Stanford University 1455) reveals specimens apparently identical to *T. glaucus*. Other specimens previously identified by other workers as *T. goodei* (USNM 68595 and 125672) are *T. glaucus*.

Ginsburg (1952: p. 72) aptly stated the basis of confusion related to *T. goodei* and the term "permit":

> The apparent existing misapprehension regarding the western Atlantic species of *Trachinotus* involves also a curious confusion of common and scientific names. In current accounts, the "permit" is generally treated under the name of *T. goodei*. However, as stated, the name "permit" apparently refers, partly or wholly, to large specimens of *falcatus*; while the type on which the name *goodei* is based, is evidently a small specimen of *glaucus* as noted under its account, and the name *goodei* must be entered in the synonymy of *glaucus*.

Further confusion results from the almost universal use of the term "permit" for any unusually large *Trachinotus*, and by its use for any *T. falcatus* on Indian River, Fla.

ONTOGENY OF *TRACHINOTUS* SPECIES

HEAD LENGTH

There is a gradual decrease in relative head length with an increase in standard length in the three species, *Trachinotus carolinus*, *T. falcatus*, and *T. glaucus*. Growth patterns in all species are essentially the same. Below about 10 mm., relative head length is about 39–44% S.L., and by about 200 mm. it has decreased to about 26–27% S.L. Above 230 mm., relative head length in *T. carolinus* is 25% S.L. or less (appendix table 2 and fig. 19).

Head lengths of 39.1% and 41.5% S.L. for the 3.07– and 4.0-mm. specimens (*Trachinotus* sp.) fall in line with the trend suggested by the data for the three species, but the value of 33.8% S.L. for the 4.66-mm. specimen is low (appendix table 2).

EYE DIAMETER

As in head length, there is a gradual decrease in relative eye diameter with an increase in standard length. Growth patterns in all three species are very similar, with *T. carolinus* and *T. glaucus* presenting virtually identical patterns and *T. falcatus* showing a slightly larger eye at any given length. Below 10 mm., eye diameters are about 13–16% S.L. for the three species, and by 210 mm. they are about 6–8% S.L. This relative decrease continues in *T. carolinus* and specimens above 300 mm. approach an eye diameter of about 5% S.L. (appendix table 2 and fig. 19).

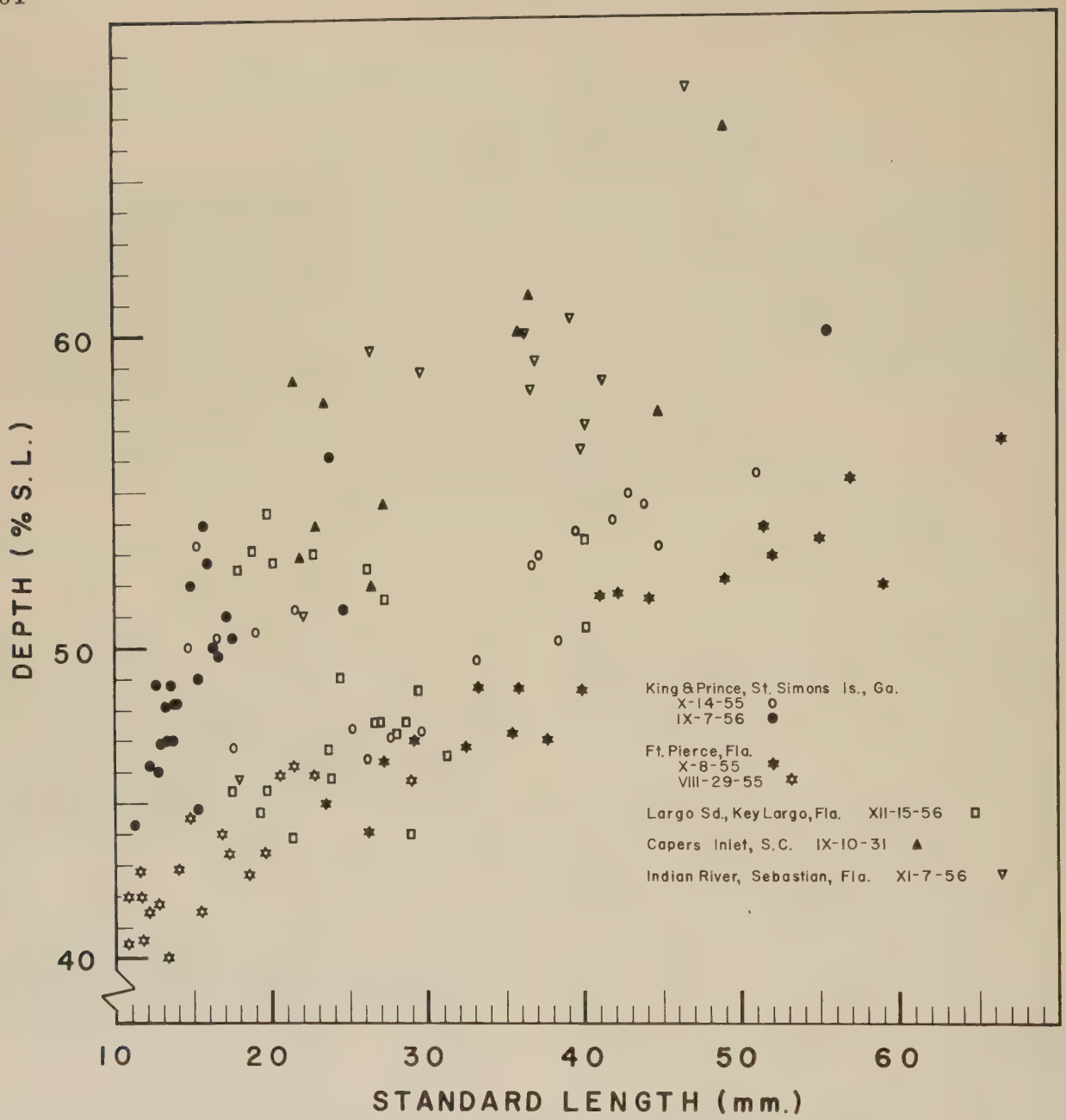

FIGURE 18.—Body-depth ranges for *T. falcatus*, expressed as percent of standard length. (Five sites on the south Atlantic coast of the United States and seven collecting dates are presented.)

In *Trachinotus* sp. eye diameters of the 3.07-, 4.0-, and 4.66-mm. specimens are 11.0, 13.2, and 11.2% S.L. (appendix table 2).

BODY DEPTH

Relative depth increases with an increase in standard length to about 120 mm. in all species. Growth patterns for *T. carolinus* and *T. glaucus* are similar, with *T. glaucus* slightly the shallower between 20 and 120 mm. *T. falcatus* is markedly deeper at all sizes. Below 10 mm., the relative depth for *T. carolinus* and *T. glaucus* is about 32–36% S.L. and increases to about 48–50% S.L. at 130 mm. Above 130 mm., this relative depth is maintained in *T. carolinus* to about 200 mm. after which it gradually decreases, with specimens about 300 mm. and above having a depth approaching 40% S.L. Below 10 mm., *T. falcatus*

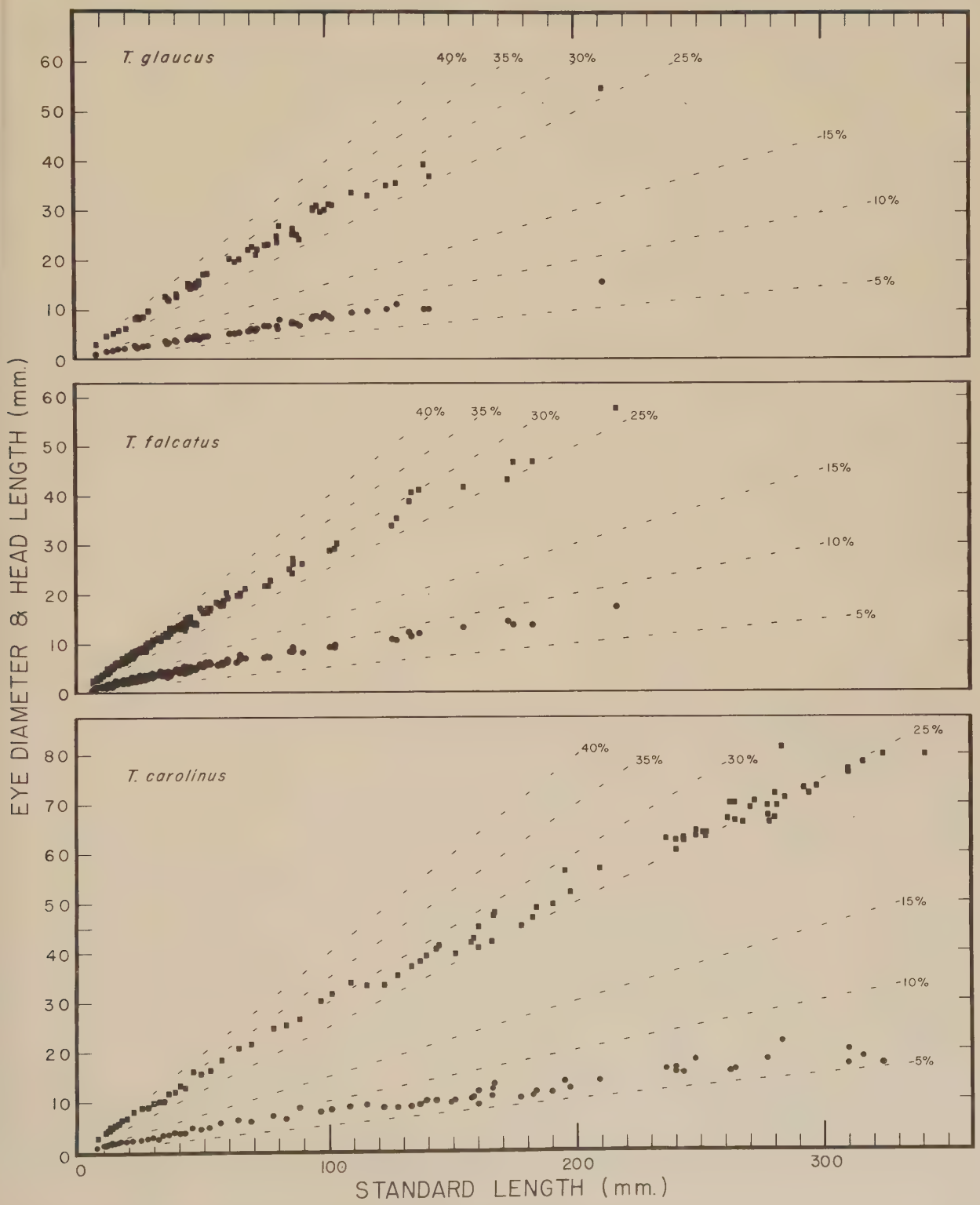

FIGURE 19.—Relation of head length (squares) and eye diameter (circles) to standard length for *T. carolinus*, *T. falcatus*, and *T. glaucus*. (Dashed lines and respective percentages are guides for determining the part dimension as percent of standard length.)

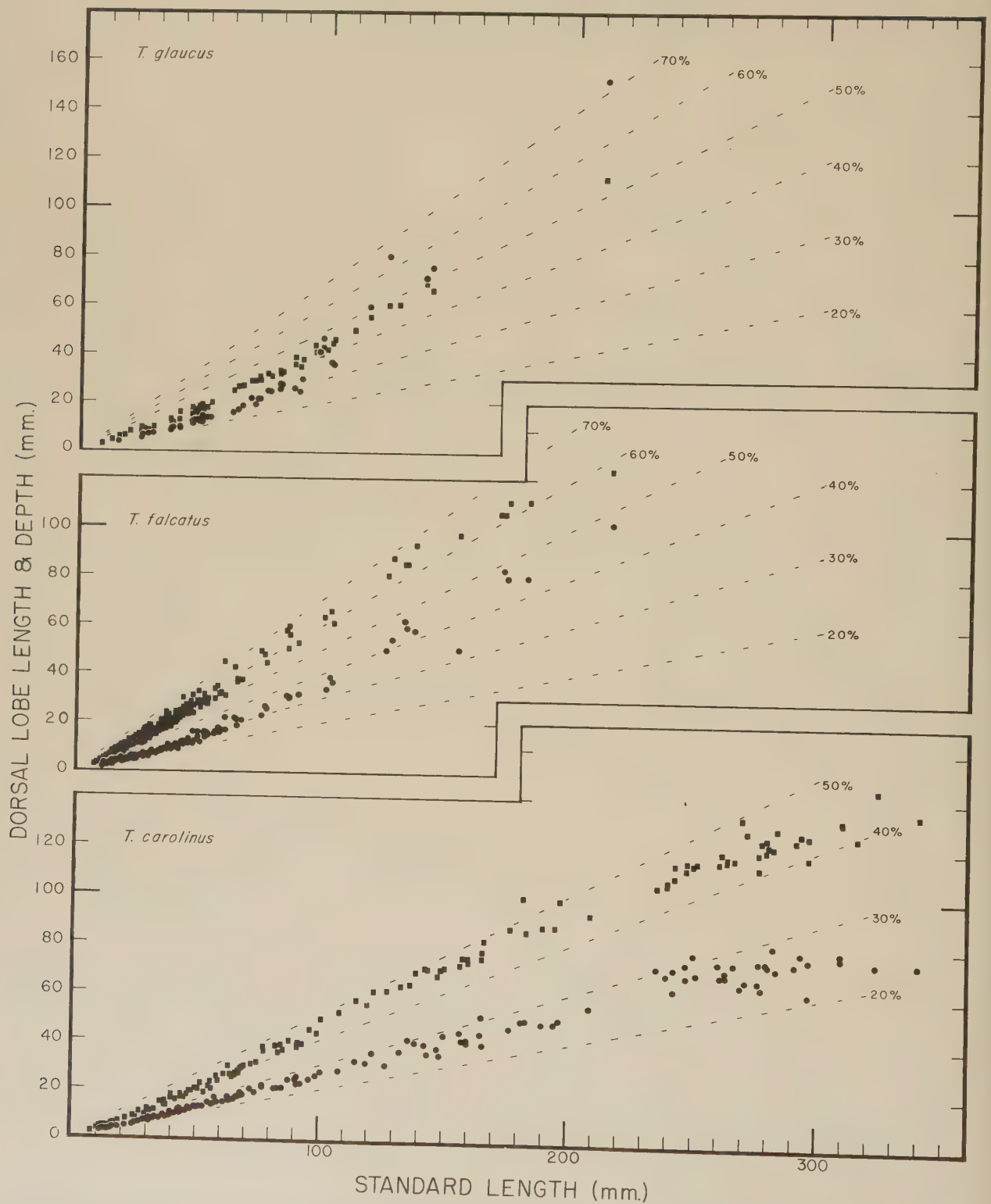

FIGURE 20.—Relation of body depth (squares) and dorsal-fin lobe length (circles) to standard length for *T. carolinus*, *T. falcatus*, and *T. glaucus*. (Dashed lines and respective percentages are guides for determining the part dimension as percent of standard length.)

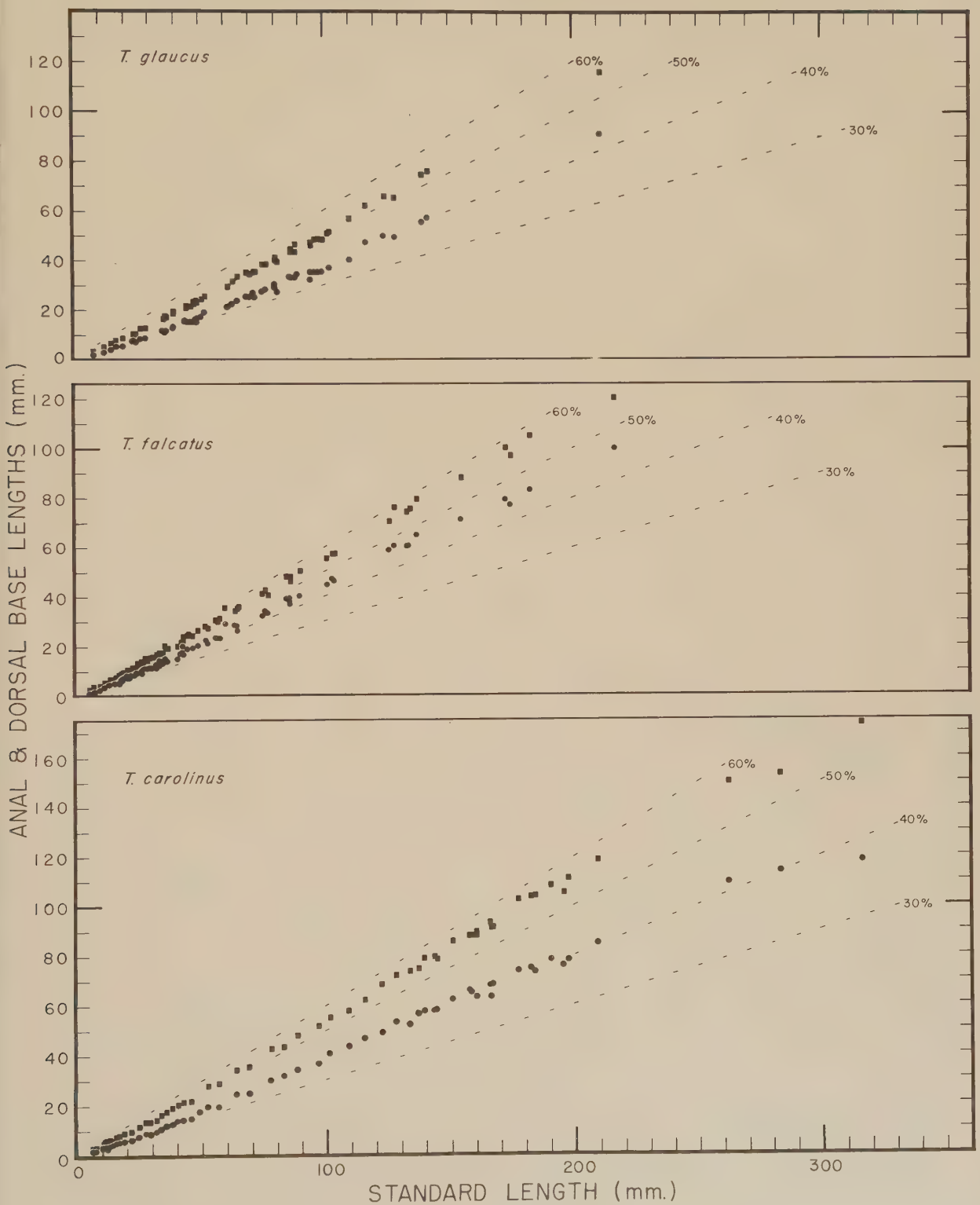

FIGURE 21.—Relation of dorsal-fin base length (squares) and anal-fin base length (circles) to standard length for *T. carolinus*, *T. falcatus*, and *T. glaucus*. (Dashed lines and respective percentages are guides for determining the part length as percent of standard length.)

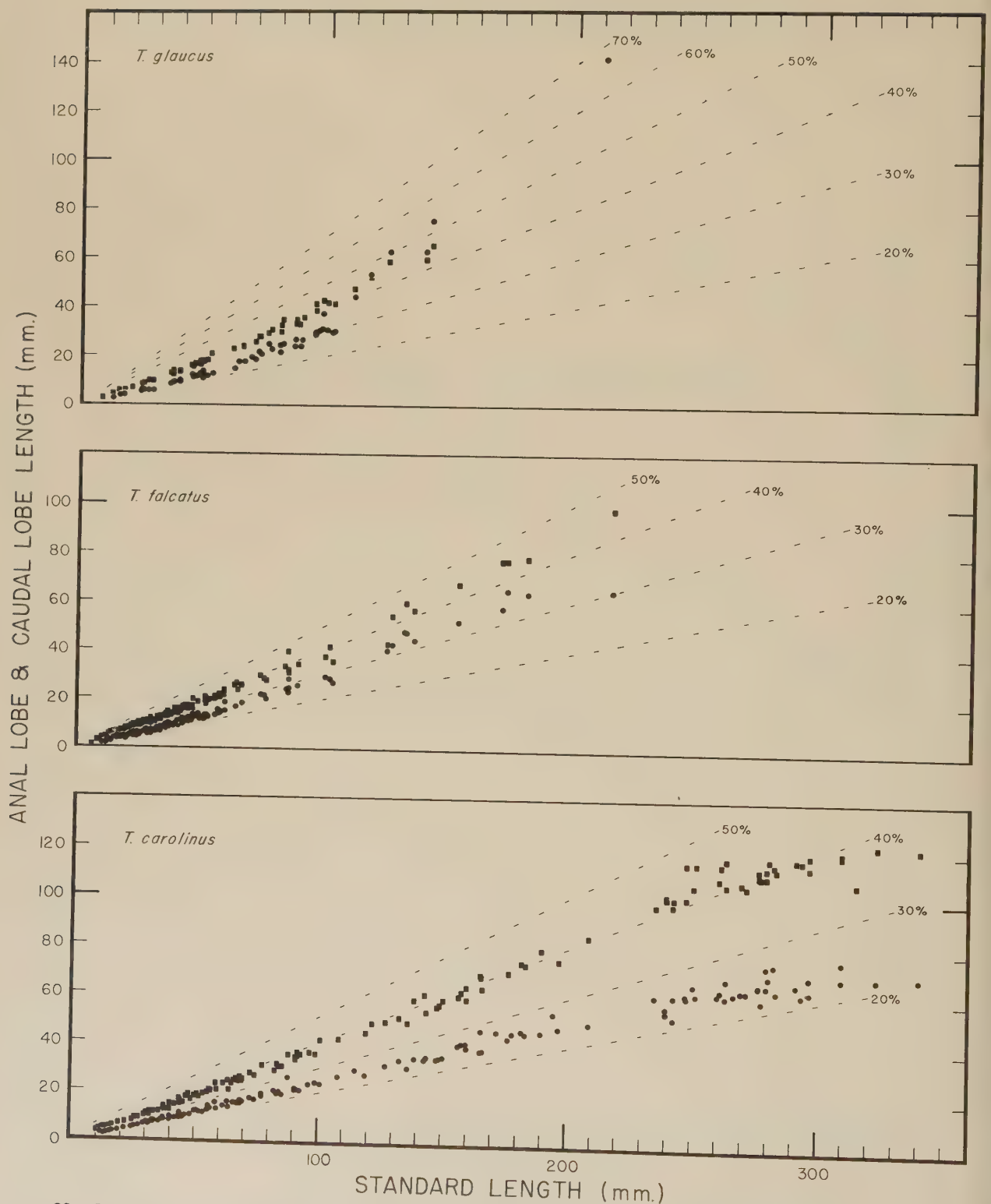

FIGURE 22.—Relation of caudal-fin lobe length (squares) and anal-fin lobe length (circles) to standard length for *T. carolinus, T. falcatus, and T. glaucus.* (Dashed lines and respective percentages are guides for determining the part length as percent of standard length.)

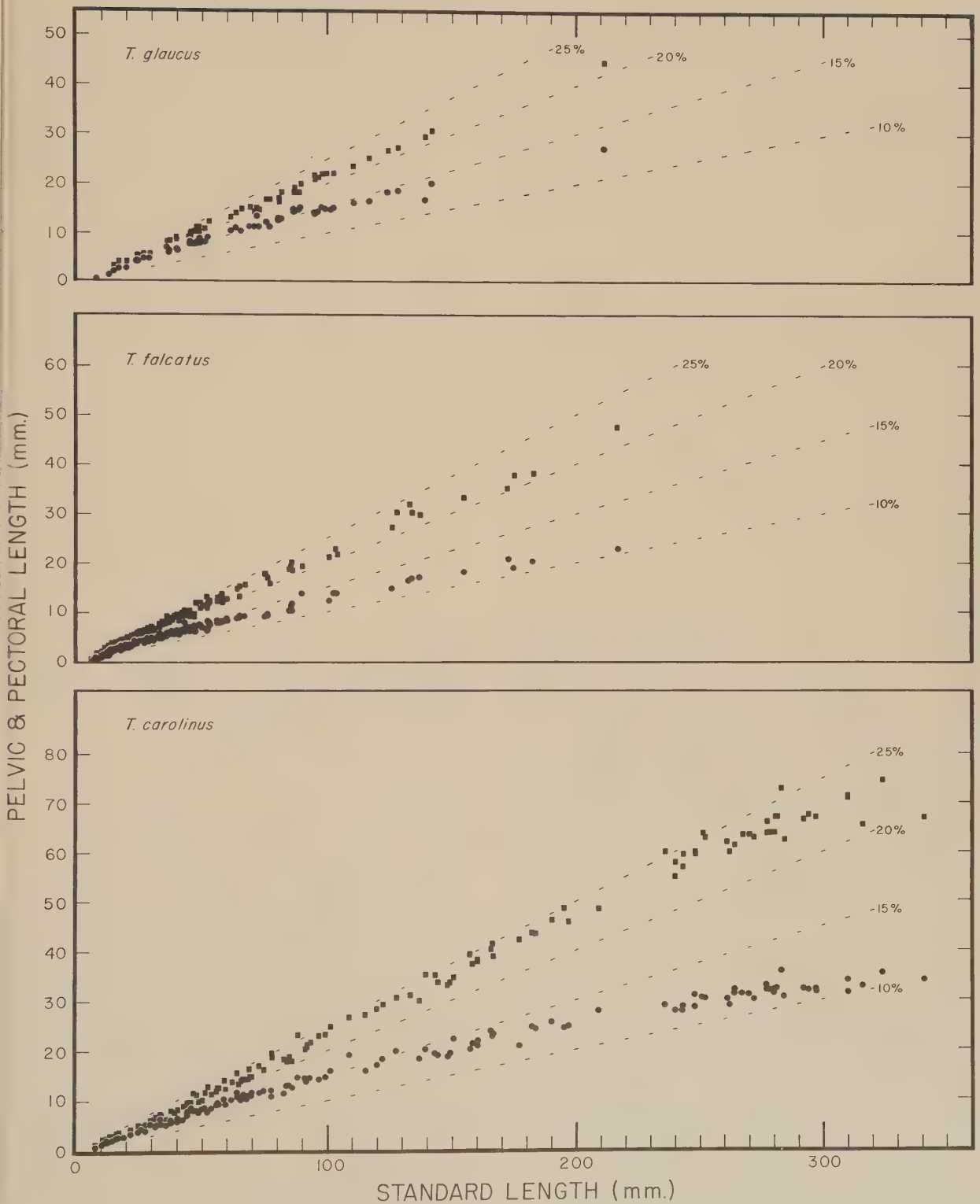

FIGURE 23.—Relation of pectoral length (squares) and pelvic length (circles) to standard length for *T. carolinus*, *T. falcatus*, and *T. glaucus*. (Dashed lines and respective percentages are guides for determining the part length as percent of standard length.)

has a relative depth of about 30–40% S.L. By 100 to 140 mm., depth has increased to about 60–68% S.L. Relative depth decreases at sizes above about 140 mm. and is less than 60% S.L. at about 200 mm. (appendix table 2 and fig. 20).

In *Trachinotus* sp., depths of the 3.07-, 4.0-, and 4.66-mm. specimens are 18.2, 19.2, and 20.2% S.L., respectively (appendix table 2).

DORSAL FIN

Elements

Trachinotus sp.—At 3.07 mm., no spines or soft-rays are discernible. At 4.0 mm., five spines and about seven soft-ray buds are barely discernible. At 4.66 mm., six spines and 20 soft-ray buds are present (figs. 1–3).

T. carolinus—Elements V to VI–I, 22 to 27. Ginsburg (1952) found that of 346 specimens he examined 51 had six (V–I) and 295 had seven (VI–I) spines; and that of 342 specimens examined 36 had 23 soft-rays, 183 had 24, 110 had 25, 12 had 26, and 1 had 27. Of 197 specimens examined in my study, 17 had six dorsal spines, and 180 had seven. Dorsal soft-ray counts were made on 172 specimens: One had 22, 12 had 23, 99 had 24, 55 had 25, and 5 had 26 dorsal soft-rays (table 1). Spines are prominent, and soft-rays are developed by about 7 mm. (fig. 4). At this size all but about six of the soft-rays are segmented; none is branched. All soft-rays are segmented by about 10 mm. Branching occurs at about 18–20 mm. in all soft-rays except the first (anteriormost), which branches at approximately 40 mm.

T. falcatus.—Elements VI–I, 17 to 21. Ginsburg (1952) examined 24 specimens and found all to have seven dorsal spines. One specimen had 18 dorsal soft-rays, 16 had 19_1 and 7 had 20. All 386 specimens examined for this character in my study had seven (VI–I) dorsal spines. One specimen had 17 soft-rays, 13 had 18, 255 had 19, 113 had 20, and 4 had 21 (table 2). Spines are prominent in the 5.0-mm. specimen (fig. 8), and the individual soft-rays discernible. No segmentation or branching has occurred. By about 6.5 to 9 mm. all but 1 to 3 soft-rays have segmented. All are segmented after about 9.5 mm. Branching begins at about 12 mm., and all soft-rays except the first are branched by about 17 mm. Branching is completed by about 20 to 24 mm.

TABLE 1.—*Dorsal and anal soft-ray relation for 172 specimens of* Trachinotus carolinus

[Upper numbers in blocks represent specimens with the indicated combination; numbers in parentheses represent approximate percentage of the sample with that combination]

ANAL SOFT-RAYS	DORSAL SOFT-RAYS 22	23	24	25	26	Total anal rays
20	1 (0.6)	2 (1.2)	5 (2.9)			8 (4.7)
21		9 (5.2)	40 (23.3)	13 (7.6)	1 (0.6)	63 (36.6)
22		1 (0.6)	53 (30.8)	37 (21.5)	3 (1.7)	94 (54.7)
23			1 (0.6)	5 (2.9)	1 (0.6)	7 (4.1)
Total dorsal rays	1 (0.6)	12 (7.0)	99 (57.6)	55 (32.0)	5 (2.9)	

TABLE 2.—*Dorsal and anal soft-ray relation for 386 specimens of* Trachinotus falcatus

[Upper numbers in blocks represent specimens with the indicated combination; numbers in parentheses represent approximate percentage of the sample with that combination]

ANAL SOFT-RAYS	DORSAL SOFT-RAYS 17	18	19	20	21	Total anal rays
16		2 (0.5)	2 (0.5)			4 (1.0)
17	1 (0.3)	9 (2.3)	147 (38.1)	42 (10.9)		199 (51.6)
18		2 (0.5)	106 (27.5)	71 (18.4)	3 (0.8)	182 (47.2)
19					1 (0.3)	1 (0.3)
Total dorsal rays	1 (0.3)	13 (3.4)	255 (66.1)	113 (29.3)	4 (1.0)	

T. glaucus.—Elements VI–I, 19 or 20. All 39 specimens examined by Ginsburg (1952) had seven dorsal spines; 23 had 19 soft-rays and 16 had 20. All 74 specimens I examined had seven (VI–I) dorsal spines; 45 had 19 soft-rays and 29 had 20 (table 3). In the 7.8-mm. specimen (fig. 14) all soft-rays but the anteriormost and the last three are segmented. Segmentation is complete in the 11.8-mm. specimen (fig. 15). Branching has not begun by about 19 mm.; but all soft-rays except the first are branched by about 23 mm., and the first soft-ray branches between 28 and 35 mm.

Lengths

The dorsal fin possesses no lobe at sizes smaller than about 11 mm.; i.e., the anterior distal margin

s uniformly rounded. At about 11 mm., the fin margin becomes angular at the tips of soft-rays 2–4 or 5 and forms an indistinct lobe. Relative dorsal-fin lobe length increases with increased standard length at about the same rate in all species to a size of about 50 mm. At about 10–20 mm., these lengths are about 20% S.L. for *T. carolinus* and *T. falcatus* and about 22% S.L. for *T. glaucus*. By 40 to 50 mm., the lengths are about 22–25% S.L. for *T. carolinus* and about 22–29% S.L. for *T. glaucus* and *T. falcatus*. *T. carolinus* maintains a dorsal lobe length of about 24–29% S.L. from 50 mm. to above 200 mm., where there is a slight increase in relative lobe length to about 27–30% S.L. at 230–260 mm. Above 260 mm. there is a decrease in relative lobe length in *T. carolinus*, approaching about 22% S.L. in the largest specimens. Relative dorsal lobe length increases with increased standard length in *T. falcatus* and *T. glaucus* to the largest sizes examined—47% S.L. in the 216.5-mm. *T. falcatus* and 72% S.L. in the 211-mm. *T. glaucus* (appendix table 2 and fig. 20).

TABLE 3. *Dorsal and anal soft-ray relation for 74 specimens of* Trachinotus glaucus.

[Upper numbers in blocks represent specimens with the indicated combination; numbers in parentheses represent approximate percentage of the sample with that combination]

		DORSAL SOFT-RAYS		Total anal rays
		19	20	
ANAL SOFT-RAYS	16	2 (2.7)	1 (1.3)	3 (4.0)
	17	35 (47.3)	17 (23.0)	52 (70.3)
	18	8 (10.8)	11 (14.9)	19 (25.7)
Total dorsal rays		45 (60.8)	29 (39.2)	

Relative dorsal base lengths increased gradually with increased standard length to about 120 to 130 mm. in *T. carolinus* and *T. glaucus*, and increase rapidly in *T. falcatus* to about 70 mm. Below 10 mm., dorsal base lengths are about 41%, 43%, and 42% S.L. for *T. carolinus*, *T. falcatus*, and *T. glaucus*, respectively. Above 10 mm., *T. glaucus* averages the shortest, and *T. falcatus* the longest relative dorsal base lengths. By about 80 mm., the base lengths for *T. carolinus*, *T. falcatus*, and *T. glaucus* are about 53%, 57%, and 50% S.L., respectively. Beyond 80 mm., *T. falcatus* maintains a base length of about 55–59% S.L., and by 180 mm., *T. carolinus* reaches its maximum relative base length of about 57–58% S.L. The relative length of this part increases with increased standard length throughout the specimens of *T. glaucus* examined with the 211-mm. specimen possessing a dorsal base length 55% S.L. (appendix table 2 and fig. 21).

ANAL FIN

Elements

Trachinotus sp.—At 3.07 to 4.66 mm. the spines are barely discernible. No rays are present at 3.07 and 4.0 mm., but 15 soft-ray buds are evident in the 4.66-mm. specimen (figs. 1–3).

T. carolinus.—Elements II–I, 20 to 23. Ginsburg (1952) examined 346 specimens; 4 had 20 soft-rays, 127 had 21, 188 had 22, and 27 had 23. Of 172 specimens examined in this study 8 had 20 soft-rays, 63 had 21, 94 had 22, and 7 had 23 (table 1). Spines are prominent and soft-rays are developed by about 7 mm., and all but about 5 of the soft-rays are segmented (fig. 4). All soft-rays are segmented by about 10–11 mm. (fig. 5). Branching of all soft-rays but the first begins at about 17 mm. and is complete by about 21 mm. The first soft-ray branches at about 27 mm.

T. falcatus.—Elements II–I, 16 to 19. Of the 24 specimens examined by Ginsburg (1952) 15 had 17 and 9 had 18 anal soft-rays. Of 386 specimens examined in this study, 4 had 16 anal soft-rays, 199 had 17, 182 had 18, and 1 had 19 (table 2). At 5.0 mm. (fig. 8) the spines are prominent and the individual rays are discernible, but none is segmented. By 6.5–8 mm., all but 1 to 5 of the soft-rays are segmented, and by 9 mm., all anal soft-rays are segmented. Branching begins at about 13 mm. and is complete at 18 to 19 mm.

T. glaucus.—Elements II–I, 16 to 18. Ginsburg's (1952) 39 specimens were composed of 4 individuals with 16 anal soft-rays, 23 with 17, and 12 with 18. Of 74 specimens examined by me, 3 had 16 anal soft-rays, 52 had 17, and 19 had 18 (table 3). All rays but the anteriormost and the posteriormost are segmented in the 7.8-mm. specimen, and segmentation is complete in the 11.8-mm. individual (figs. 14 and 15). Branching has not begun by 19 mm., but is completed in some individuals by about 22 mm. The anterior-

most soft-ray does not branch in some specimens until about 28 mm.

Lengths

The anal-fin lobe becomes discernible at about 11 mm. Relative length of the anal-fin lobe increases with increasing standard length to about 60 mm. in *T. carolinus*. A similar increase occurs in *T. falcatus* and *T. glaucus* and continues throughout all sizes examined, except in large *T. falcatus* of 170 to 190 mm., which reach about 36% S.L., and in the largest *T. glaucus* which reach about 67% S.L. At 10–20 mm., anal-fin lobe lengths for *T. carolinus*, *T. falcatus*, and *T. glaucus* are about 18–20%, 18–22%, and 22% S.L., respectively, and by about 60 mm. they are about 22–25%, 24–26%, and 23–27% S.L., respectively. *T. carolinus* maintains a lobe length of 23–26% S.L. to about 280 mm., after which relative length decreases to about 21–24% S.L. (appendix table 2 and fig. 22).

Relative anal-fin base length increases with increasing standard length to about 100 mm. in *T. carolinus* and *T. falcatus*. Relative length increases in all sizes of *T. glaucus*, approaching 43% S.L. at 211 mm. Below 10 mm., base lengths for *T. carolinus*, *T. falcatus*, and *T. glaucus* are about 27%, 29%, and 28% S.L. respectively, and at about 100 mm., the base lengths are about 40%, 45%, and 37% S.L. *T. carolinus* and *T. falcatus* maintain relative anal-base lengths of about 38–42% S.L. and 45–47% S.L., respectively, between about 100 and 280 mm. in *T. carolinus*, and between about 100 and 216 mm. in *T. falcatus* (appendix table 2 and fig. 21).

PECTORAL FIN

Elements

Trachinotus sp.—No spines or soft-rays are evident at 3.07 and 4.0 mm. (figs. 1 and 2). Four or five soft-rays are barely discernible at 4.66 mm. (fig. 3).

T. carolinus.—Elements I, 16 to 18. Ginsburg (1952) shows the pectoral soft-ray range (compensated) as 16 to 18 on 174 specimens; 15 specimens had 16 soft-rays, 130 had 17, and 29 had 18. Of 102 specimens I examined, 14 had 16 soft-rays, 75 had 17, and 13 had 18 (table 4). At about 7 mm., all but about 4 of the soft-rays are segmented and, by about 11 mm., all rays have segmented and branching has probably begun (it is difficult to examine the innermost, or lowermost rays in small specimens, therefore error is possible in determining when these soft-rays segment or branch). Branching is complete by about 21 mm. The uppermost ray (adjacent to the spine) remains unbranched.

T. falcatus.—Elements I, 17 to 19. In examining 17 specimens, Ginsburg (1952) found two with 17 soft-rays, 14 with 18, and 1 with 19. In 78 specimens I examined, 29 had 17 soft-rays, 47 had 18, and 2 had 19 (table 4). At 5.0 mm., the individual rays are discernible, but no segmenting has occurred. By about 7 mm., all but 4 to 5 soft-rays are segmented and segmentation is complete at about 9–12 mm. Branching begins at about 14 mm., and most has occurred by 20 mm. In some individuals branching is complete by 17 mm., whereas in others it is not complete until about 45 mm.

TABLE 4.—*Pectoral soft-ray counts for* Trachinotus carolinus, T. falcatus, *and* T. glaucus

[Upper numbers in blocks represent specimens with the indicated combination; numbers in parentheses represent approximate percentage of the sample with that combination]

	PECTORAL SOFT-RAYS				
	15	16	17	18	19
T. carolinus (102 specimens)		14 (13.7)	75 (73.5)	13 (12.7)	
T. falcatus (78 specimens)			29 (37.2)	47 (60.3)	2 (2.6)
T. glaucus (71 specimens)	1 (1.4)	8 (11.3)	52 (73.2)	8 (11.3)	2 (2.8)

T. glaucus.—Elements I, 15 to 19. Thirty-six specimens examined by Ginsburg (1952) showed 2 specimens with 15 soft-rays, 5 with 16, 24 with 17, and 5 with 18. Of 71 specimens I examined, 1 had 15 soft-rays, 8 had 16, 52 had 17, 8 had 18, and 2 had 19 (table 4). All soft-rays are segmented by 11.8 mm. and branching has begun by about 16 mm. By about 19 mm., all but 3 to 10 soft-rays are branched and branching is complete by 35 to 48 mm.

Lengths at sizes below 10 mm., *T. carolinus* and *T. falcatus* have pectoral-fin lengths about 19% and 13–22% S.L., respectively. At 10–20 mm., *T. glaucus* and *T. falcatus* have reached their maximum relative pectoral-fin lengths of about 25% S.L. Relative pectoral length increases in *T. carolinus* to about 22–25% S.L. at about 70 to 80 mm. (appendix table 2 and fig.23). Relative pectoral-fin lengths are constant above

0 mm. in all species, with *T. carolinus*, *T. falcatus*, nd *T. glaucus* maintaining pectoral lengths of 2–25%, 21–24%, and 21–22% S.L., respectively, o about 210–220 mm. S.L. Above 230 mm., *T. arolinus* continues a pectoral-length range of 2–25% S.L., with the largest specimen (341 mm.) ossessing a pectoral length of about 19% S.L.

PELVIC FIN

lements

Trachinotus sp.—There is no evidence of the fin t 3.07 and 4.0 mm., but at 4.66 mm. buds are iscernible (figs. 1–3).

T. carolinus.—Elements I, 5. All soft-rays are egmented but none are branched before 10–12 nm. Between 12 and 16 mm. various states of ranching are apparent, and after about 16 mm. ranching is complete.

T. falcatus.—Elements I, 5. At 5.0 mm. the elvic fins are minute buds, and by about 6.5 mm. he fins are small, flattened, flipperlike structures vithout spine or soft-rays. Spines and soft-rays re discernible at about 7 to 7.5 mm. (one 7.3-mm. pecimen possesses a spine but no discernible soft-ays, the other specimens have the full comple-nent). Segmentation begins at about this size nd is completed by about 9.5 mm. Branching ommences at about 11–12 mm. and is completed t 14–18 mm.

T. glaucus.—Elements I, 5. At 7.8 mm. all oft-rays are segmented, and branching is complete y 11.8 mm.

engths

Relative pelvic-fin length increases very rapidly n all species from about 5–11% S.L. at sizes elow 10 mm. to about 16–17% S.L. at about 0 mm. *T. carolinus* maintains a pelvic length of bout 15–19% S.L. to about 100 mm., after which elative pelvic length decreases gradually, becom-ng about 10% S.L. at sizes larger than about 90 mm. Relative pelvic length decreases gradu-lly with an increase in standard length in *T. alcatus* at sizes above about 30 mm., becoming bout 11% S.L. in specimens larger than 170 mm. *T. glaucus* maintains a pelvic length about 17% S.L. to about 70 mm., after which there is a radual relative decrease with an increase in tandard length, becoming 13% S.L. in the 211-mm. specimen (appendix table 2 and fig. 23).

CAUDAL FIN

Elements

Trachinotus sp.—At 3.07 and 4.0 mm. the caudal rays are not evident, but at 4.66 mm., six principal rays in each lobe are discernible (figs. 1–3).

T. carolinus. Rays 9+8. All principal rays are present and segmented, but none is branched at 7.2 mm. The two median caudal rays branch at about 10 mm., by about 11 mm. five or six rays in the upper lobe and about five in the lower lobe are branched, and branching is complete at 15–20 mm.

T. falcatus.—Rays 9+8. By 5–7 mm. all principal rays are present, and all but the outermost principal ray in each lobe are segmented. Segmentation is complete between 7 and 7.5 mm. Branching begins with the median caudal rays and is complete by about 12 mm.

T. glaucus.—Rays 9+8. At 7.8 mm. all principal rays are present and segmented, but none is branched. At 11.8 mm. six rays in the upper lobe and five in the lower are branched, and by 14.6 mm. seven upper rays and six lower ones are branched. All specimens larger than about 15 mm. exhibit complete branching.

Lengths

Relative caudal-fin lobe length gradually increases with an increase in standard length to about 250 mm. in *T. carolinus*. Maximum relative length of this part is undetermined in *T. falcatus* and *T. glaucus* since a continuing and moderate increase was indicated by the largest specimens examined. Below 10 mm. *T. falcatus* and *T. glaucus* exhibit caudal-fin lobe lengths about 25–35% and 33% S.L., respectively. At 10–30 mm., the lengths of this part for *T. carolinus*, *T. falcatus*, and *T. glaucus* are about 31–34%, 31–38%, and 35% S.L., respectively. Caudal-fin lobe length in *T. carolinus* increases to about 41–44% S.L. at 230 to 260 mm.; thereafter, the part decreases in relative length, approaching 35% S.L. at sizes larger than 300 mm. The four largest *T. falcatus* (172–216.5 mm.) had caudal lobe lengths 42.9–45.5%, and three of the larger *T. glaucus* (124–141.5 mm.) had caudal lobe lengths 42.8–47.3% S.L. (appendix table 2 and fig. 22).

GILL RAKERS

The complete gill-raker complement in *Trachinotus* is 7 or 8+13 or 14. This complement

is very seldom encountered, however, because of damage to the arch, destruction of rakers by parasitic isopods, and natural degeneration of gill rakers. No specimens examined had the complete complement of rakers fully developed, but they exhibited the possibility of having possessed the full complement of gill rakers at some time; i.e., they had enough rudiments or tubercles or adequate space on the ends of the arch to account for missing rakers. The separation of gill rakers from rudiments is arbitrary, the criterion used here is that a raker so shortened as to be covered with flesh and to have no appreciable flexibility is considered rudimentary.

Gill-raker degeneration usually begins at the ends of the arch and progresses toward the angle. The outermost rakers first become rudimentary and later become low tubercles. As the rudiments degenerate to tubercles other tubercles form between the gill-raker sites and masses of low tubercles form along the ends of the arch. Quite often tubercles form between fully developed rakers, especially in larger fish.

Trachinotus sp.—Gill rakers were not examined.

T. carolinus.—Rakers 7+13. Some specimens to about 310 mm. possessed the maximum number (including rudiments) on one limb of the arch. Degeneration is more pronounced on the lower limb, generally progressing with increase in size. Specimens at all sizes above 10 mm. exhibit a complement of 4 to 6 fully developed rakers in the upper arch. On the lower arch, 10- to 30-mm. specimens exhibit a range of 10 to 12 fully developed rakers (the majority have 11); at 50 to 80 mm. the range is 9–11 (half the specimens have 10); and from 80 mm. on the range is 6–10 (most specimens have 8 or 9).

T. falcatus.—Rakers 8+14. At smaller sizes (10–40 mm.) the gill-raker range is 3–8+12–14, with most specimens possessing 5 or more rakers on the upper limb. From 40 to 100 mm. the range is 5–7+10–14 (numbers evenly distributed for upper limb, but with about half the specimens with 12 rakers in the lower limb.) Above 100 mm. the range is 3–7+8–13 (with more specimens having 5 than any other count on the upper limb and with a majority having 11 or 12 on the lower limb).

T. glaucus.—Rakers 8+14. At 10 to 60 mm. the range is 3–8+9–14 (most specimens have 5 or 6 on the upper limb and 11 or 12 on the lower limb); at 60 mm. and above, it is 4–8+10–11 (about half the specimens have 6 on the upper limb and the majority have 10 on the lower limb). There is a tendency toward reduction in the number of fully developed gill rakers with increasing size of the fish.

PREOPERCULAR SPINES

Very small *Trachinotus* possess two series of conspicuous preopercular spines (figs. 1, 2, and 3). The series of preopercular-margin spines is located along the edge of the preopercle. Anterior and parallel to this is the series of preopercular-face spines. The margin series consists of three primary margin spines, at and near the angle, the middle (PMS 1) the longest and the upper (PMS 2) and lower (PMS 3) being somewhat shorter. These are followed on both limbs by preopercular-margin secondary spines. The secondary spines on the lower limb number two or three and remain fairly constant in number and relative size. The upper secondary spines are few in number at small sizes but increase in number and decrease in size as the fish grows, the result being a finely serrated margin on the upper limb during the latter stages of preopercular-spine development. This is especially true of *T. falcatus*.

The preopercular-face series consists of two or three rather obtuse spines positioned relatively the same as the primary angle spines in the margin series (PFS 1 to 3). These spines, very conspicuous in small specimens, become relatively smaller with increase in fish size and disappear at about 13 mm. The margin series remains conspicuous in fish to the larger sizes.

At about 13 mm. the preopercle begins to grow laterally, and flat, bony projections begin to radiate between and encroach upon the margin spines. As this encroachment progresses the spines are assimilated into the bony mass with the uppermost and lowermost spines disappearing first. In turn, the bony mass may radiate from the edges of the spines as the spines become a part of the preopercle. In conjunction with this process, the larger spines, primary and lower limb, become overgrown with flesh prior to bony encroachment. Any spine so covered is considered assimilated.

Other bony projections in small *Trachinotus* are a ridge over and behind the brow and short

pines near the upper end of the gill opening figs. 1–3).

Trachinotus sp.—In the 3.07-mm. specimen, he three primary margin spines are present, superimposed by two spines of the preopercular ace series. The 4.0- and 4.66-mm. fish have hree primary margin spines and three primary ace spines (figs. 1–3).

T. carolinus.—At 7.2 mm. there are two spines n the lower limb and one on the upper limb of he margin series, plus the angle spines. Only ne face spine (PFS 3) is obvious, the other two re virtually extinct (fig. 4). By 11 mm. there re three spines on the lower limb and four on he upper, plus the angle spines, in the margin eries. Two face spines (PFS 1 and 3) are pres-nt but reduced (fig. 5). The face spines are bliterated, and the margin spines reach their naximum numerical development at 12 to 13 mm. By 18 to 20 mm. all but the primary margin spines have become assimilated into the pre-opercle. PMS 2 and 3 are not obvious after about 24 mm. PMS 1 is the last to be assimilated, usually at about 33 mm., but is sometimes dis-cernible to about 45 mm., and occasionally the very tip of this spine remains uncovered after the preopercular margin has grown past it.

T. falcatus.—At 5.0 mm. the primary spines and one lower limb secondary spine are found in the margin series, and the face series is comprised of three spines (fig. 8). By about 7 mm. there are two spines on the upper limb and two on the lower limb of the margin series, and three face spines are present but receding (fig. 9). By 11 mm. there are two spines on the lower limb and about five on the upper limb of the margin, and the three face spines are relatively small. In 13- to 20-mm. specimens, two or three spines comprise the lower limb margin complement, two to many spines are found on the upper limb, and the face series has disappeared (fig. 10). Preopercular encroachment and spine assimilation are rapid beyond this size, and only the primary spines are conspicuous between 20 and 30 mm. By 30 to 32 mm. all spines are assimilated.

T. glaucus.—At 7.8 mm. two spines are evident on the upper limb and none on the lower limb of the margin. Three distinct face spines are present (fig. 14). At 11.8 mm. the face spines have disappeared, and there are three margin spines on the upper limb and two on the lower (fig. 15). At 14.6 mm. three spines are present on each limb of the margin (fig. 16). After about 23 mm., PMS 1 is the only spine remaining up-covered. This spine is assimilated at about 28 to 35 mm.

BRANCHIOSTEGAL RAYS

Branchiostegal rays were counted on specimens in which the opercular flap was flared outward, thereby presenting well-spread branchiostegal membranes. In some specimens the innermost rays are very narrow and inconspicuous and are "floating" or unattached.

Trachinotus sp.—The 3.07-mm. specimen has a complement of 5 or 6+5 or 6; the 4.0- and 4.66-mm. specimens have 7+7 branchiostegal rays.

T. carolinus.—Rays, usually 7+7. Of 220 specimens examined, 195 had 7+7 branchiostegal rays, 9 had 7+8, 9 had 8+7, 6 had 8+8, and 1 had 8+9 (table 5).

T. falcatus.—Rays, usually 8+8. Of 203 specimens examined, 117 had 8+8 branchiostegal rays, 9 had 7+8, 23 had 8+7, 53 had 7+7, and 1 had 6+7 (table 6).

T. glaucus.—Rays, usually 8+8. Of 49 individuals examined, 44 had 8+8 branchiostegal rays, 3 had 7+7, 1 had 7+8, and 1 had 8+7 (table 7).

DENTITION

The following description of dentition in *Trachinotus* was obtained from specimens 20 to 60 mm. in length, but applies to all sizes in which teeth are evident. The teeth on the premaxillaries and dentaries are small, rather slender, conical, and recurved. An irregular, double row of

TABLE 5.—*Left and right branchiostegal ray relation for 220 specimens of* Trachinotus carolinus

[Upper numbers in blocks represent specimens with the indicated combination; numbers in parentheses represent approximate percentage of the sample with that combination]

		LEFT		Total right rays
		7	8	
RIGHT	7	195 (88.6)	9 (4.1)	204 (92.7)
	8	9 (4.1)	6 (2.7)	15 (6.8)
	9		1 (0.5)	1 (0.5)
Total left rays		204 (92.7)	16 (7.3)	

TABLE 6.—*Left and right branchiostegal ray relation for 203 specimens of* Trachinotus falcatus

[Upper numbers in blocks represent specimens with the indicated combination; numbers in parentheses represent approximate percentage of the sample with that combination]

		LEFT			Total right rays
		6	7	8	
RIGHT	7	1 (0.5)	53 (26.1)	23 (11.3)	77 (37.9)
	8		9 (4.4)	117 (57.6)	126 (62.1)
Total left rays		1 (0.5)	62 (30.5)	140 (69.0)	

TABLE 7.—*Left and right branchiostegal ray relation for 49 specimens of* Trachinotus glaucus

[*Upper* numbers represent specimens with the indicated combination; numbers in parentheses represent approximate percentage of the sample with that combination]

		LEFT		Total right rays
		7	8	
RIGHT	7	3 (6.1)	1 (2.0)	4 (8.2)
	8	1 (2.0)	44 (89.8)	45 (91.8)
Total left rays		4 (8.2)	45 (91.8)	

strongly recurved teeth runs most of the length of the inner edge of the premaxillaries. The remainder of the "gum" surface is covered with minute papillae. A single irregular row of slightly larger teeth of the same type, 8 to 10 teeth to each side, is located on the outer edge of each dentary for approximately half its length from the symphysis, and 2 or 3 teeth are located on each side, immediately behind the row, adjacent to the symphysis. An irregular, double row of smaller, strongly recurved teeth is located along the inner edge of the dentary for most of its length. The area between the single row and the double rows is covered with papillae.

There are 3 to 5 short, slightly recurved teeth on the head of the vomer, and a single row of about 5 slender teeth on each palatine. The teeth present on the tongue (of *T. falcatus* only) are in a narrow band on the middle of the tongue.

Some or all the teeth become overgrown with flesh and papillae as the size of the fish increases. The erratic dentition development found in some phases of this study may be effected by the preserving medium. The inherent shrinking of flesh in alcohol-preserved fish may bare teeth that would be undetectable in specimens preserved in formalin.

Trachinotus sp.—The only teeth evident at 3.07 mm. are one or two recurved ones projecting slightly forward on the anterior ends of the premaxillaries. Premaxillary teeth are also the only ones evident in the 4.0- and 4.66-mm. specimens.

T. carolinus.—Teeth are present on premaxillaries, vomer, palatines, and dentaries of the smallest specimen and all below about 20 mm. Above 20 mm. the vomerine and palatine teeth become overgrown in some specimens, although they can still be found in others up to 150 mm. At about 150 mm. all but the dentary teeth disappear and they are gone by about 170 mm.

T. falcatus.—The 5-mm. specimen has teeth on the premaxillaries, vomer, palatines, and dentaries, but has no teeth on the tongue. At 10 to 80 mm., teeth are present also on the tongue. At 80–140 mm., some specimens have no teeth on the vomer, palatines, or tongue; at 140–190 mm., teeth are found only on the tongue and dentaries; and the 216.5-mm. individual is toothless.

T. glaucus.—Teeth are present on premaxillaries, vomer, palatines, and dentaries of the 7.8-mm. specimen, and persist to at least 140 mm. The 211-mm. individual lacks teeth on the vomer.

LITERATURE CITED

ANDERSON, A. W., and E. A. POWER.
1957. Fishery statistics of the United States, 1955. U.S. Fish and Wildlife Service Statistical Digest 41, 446 p.

BEAN, TARLETON H.
1903. Catalogue of the fishes of New York. New York State Museum, Bulletin 60, Zoology 9, 784 p.
1906. A catalogue on the fishes of Bermuda, with notes made in 1905 for the Field Museum. Field Columbian Museum Publication 108, Zoology Series, vol. 7, no. 2, p. 21–89.

BEEBE, WILLIAM, and JOHN TEE-VAN.
1928. The fishes of Port-au-Prince Bay, Haiti. Zoologica, vol. 10, no. 1, p. 1–279.
1933. Field book of the shore fishes of Bermuda. G. P. Putnam's Sons, New York, xiv + 337 p.

BREDER, CHARLES M., JR.
1923. Certain fishes from Sandy Hook Bay. Copeia, 1923, no. 114, p. 2–3.
1926. Fish notes for 1925 from Sandy Hook Bay. Copeia, 1926, no. 153, p. 121–128.

1928. Fish notes for 1927 from Sandy Hook Bay. Copeia, 1928, no. 166, p. 5–7.

1948. Field book of marine fishes of the Atlantic Coast from Labrador to Texas. G. P. Putnam's Sons, New York, Revised Edition, 5th Impression, xxxviii + 332 p., 16 pls.

Bureau of Commercial Fisheries [U.S.].

1959. Florida landings (for) 1958. U.S. Fish and Wildlife Service, Bureau Commercial Fisheries Current Fisheries Statistics no. 2001, Annual Summary, p. 1–10.

Carvalho, J. Paiva.

1941. Nota preliminar sôbre a fauna ictiológica do litoral sul do Estado de São Paulo. Boletim de Indústria Animal, Brazil, no. 150, n. s., vol. 4, nos. 3 and 4, p. 27–81.

Dekay, James Ellsworth.

1842. Zoology of New York; or the New York fauna. Part 4, Fishes. Natural History of New York Geological Survey, Albany, N.Y. xiv + 415 p. Atlas 79 pls.

Evermann, Barton Warren, and Millard Caleb Marsh.

1902. The fishes of Porto Rico. U.S. Fish Commission, Bulletin vol. 20 for 1900, pt. 1, p. 49–350, 49 col. pls.

Ginsburg, Isaac.

1952. Fishes of the family Carangidae of the northern Gulf of Mexico and three related species. Publications of the Institute of Marine Science, vol. 2, no. 2, p. 47–117, pls. 1–7.

Goode, George Brown.

1882. The carangoid fishes of the United States—pompanoes, crevallés, amber-fish, etc. U.S. Fish Commission, Bulletin vol. 1 for 1881, p. 30–43.

Gregg, William H.

1902. Where, when, and how to catch fish on the east coast of Florida. Chapter 2. The Matthews-Northrup Works, Buffalo and New York. p. 11–157, 12 col. pls.

Gunter, Gordon.

1945. Studies on marine fishes of Texas. Publications of the Institute of Marine Science, vol. 1, no. 1, p. 1–190.

1958. Population studies of the shallow water fishes of an outer beach in south Texas. Publications of the Institute of Marine Science, vol. 5, p. 186–193.

Hildebrand, Samuel F., and William C. Schroeder.

1928. Fishes of Chesapeake Bay. U.S. Bureau of Fisheries, Bulletin, vol. 43 for 1927, pt. 1, p. 1–366.

Jordan, David Starr.

1887. Notes on typical specimens of fishes described by Cuvier and Valenciennes and preserved in the Musée d'Histoire Naturelle in Paris. U.S. National Museum, Proceedings (1886), vol. 9, p. 525–546.

Jordan, David Starr, and Barton Warren Evermann.

1896. The fishes of North and Middle America: A descriptive catalogue of the species of fish-like vertebrates found in the waters of North America, north of the Isthmus of Panama. U.S. National Museum, Bulletin 47, pt. 1, lx + 1240 p.

Linton, Edward.

1905. Parasites of fishes of Beaufort, North Carolina. U.S. Bureau of Fisheries, Bulletin, vol. 24 for 1904, p. 321–428, pls. I–XXXIV.

1940. Trematodes from fishes mainly from the Woods Hole region, Massachusetts. U.S. National Museum, Proceedings, vol. 88, no. 3078, p. 1–172.

Meek, Seth E., and D. K. Goss.

1885. A review of the American species of the genus *Trachynotus*. Academy of Natural Sciences of Philadelphia, Proceedings (1884), no. 36, p. 121–129.

Meek, Seth E., and Samuel F. Hilderbrand.

1925. The marine fishes of Panama. Field Museum of Natural History Publication 226, Zoological Series, vol. 15, pt. 2, p. xv–xix + 331–707, pls. XXV–LXXI.

Nichols, John Treadwell.

1929. The fishes of Porto Rico and the Virgin Islands. Branchiostomidae to Sciaenidae. Scientific Survey of Porto Rico and the Virgin Islands. New York Academy of Sciences, vol. 10, pt. 2, p. 159–295.

1934. Young carangin fishes drifted by the Gulf Stream. Copeia, 1934, no. 1, p. 46.

Power, E. A.

1958. Fishery statistics of the United States (1956). U.S. Fish and Wildlife Service Statistical Digest 43, p. 1–476.

1959. Fishery Statistics of the United States (1957). U.S. Fish and Wildlife Service Statistical Digest 44, p. 1–429.

Rosen, Nils.

1911. Contributions to the fauna of the Bahamas. III. The fishes. Lunds Universitets Arsskrift, afd. 2, bd. 7, nr. 5, p. 46–72, 1 pl.

Smith, Hugh M.

1907. The fishes of North Carolina. North Carolina Geological and Economic Survey, vol. 2, xi + 453 p., pls. 1–21.

Springer, Victor G., and Jacques Pirson.

1958. Fluctuations in the relative abundance of sport fishes as indicated by the catch at Port Aransas, Texas, 1952–1956. Publications of the Institute of Marine Science, vol. 5, p. 169–185.

Tracy, H. C.

1910. An annotated list of the fishes known to inhabit the waters of Rhode Island. Fortieth Annual Report of the Commissioners of Inland Fisheries, p. 35–176.

APPENDIX

APPENDIX TABLE 1.—*Specimens examined, by species and collection*

[Gear: S, beach seine; T, shrimp trawl; DN, dip net; P, plankton net; L, larval-fish tow net; C, commercial catch]

Collection [1]	Number of specimens	Size (mm.)	Date of capture	Gear used
Trachinotus sp.:				
BLBG:				
Gill cruise 2, Reg. Sta. 2 (26°56′ N., 79°41′ W.)	1	3.07	4-23-53	P
Combat Sta. 302 (32°10′ N., 78°56′ W.)	1	4.0	4-22-57	L
Do	1	4.66	4-22-57	L
T. carolinus:				
BLBG:				
King and Prince Beach, St. Simons Island, Ga.	1	14	4-22-53	S
Do	23	17-24	5-6-53	S
Do	10	13-16	5-20-53	S
Do	153	16-37	6-3-53	S
Do	23	14-62	6-5-53	S
Do	29	9-57	6-17-53	S
Do	240	14-68	6-18-53	S
Do	47	17-52	7-3-53	S
Do	24	21-73	7-21-53	S
Do	23	14-60	8-26-53	S
Do	14	14-34	9-9-53	S
Do	3	34-36	12-8-53	S
Do	2	14, 19	4-25-55	S
Do	2	12, 37	5-9-55	S
Do	72	13-43	5-24-55	S
Do	67	19-47	6-9-55	S
Do	73	15-94	6-22-55	S
Do	2	27, 63.5	7-22-55	S
Do	29	14-51	8-5-55	S
Do	32	21-76	9-8-55	S
Do	29	13-65	9-19-55	S
Do	19	27-35	10-5-55	S
Do	2	24, 38	11-3-55	S
Do	3	81-102	11-16-55	S
Do	2	44, 51	12-2-55	S
Do	666	11-30	5-14-56	S
Do	87	16-40	5-28-56	S
Do	106	15-62	6-11-56	S
Do	65	22-69	6-26-56	S
Do	91	12-78	7-10-56	S
Do	35	18-31	7-24-56	S
Do	25	17-65	8-8-56	S
Do	27	14-56	8-24-56	S
Do	74	13-60	9-7-56	S
Do	77	15-54	9-27-56	S
Do	31	14-42	10-11-56	S
Do	28	13.6-42.1	10-23-56	S
Do	7	22-47	11-7-56	S
Do	14	19-42	11-20-56	S
Do	30	13-18	4-16-57	S
Do	395	12-39	5-2-57	S
Do	37	12-15	5-11-57	S
Do	20	17-52	5-16-57	S
Do	83	17-76	5-31-57	S
Do	33	13-75	6-14-57	S
Do	13	13-97	7-1-57	S
Do	45	15-127.5	7-15-57	S
Do	58	13-51	7-29-57	S
Do	22	13-60	8-13-57	S
Do	11	15-28	8-27-57	S
Do	3	15-31	9-11-57	S
Do	5	20-21	9-26-57	S
Do	111	17-47	10-11-57	S
Do	3	16-21	10-25-57	S
Do	11	13-18	4-27-59	S
Do	607	12-58	5-11-59	S
Do	104	19-73	6-9-59	S
Do	84	15-63	6-23-59	S
Do	75	13-71	7-9-59	S
Do	68	14-83	7-23-59	S
Do	49	12-101	8-7-59	S
Do	9	17-78	8-21-59	S
Do	18	41-77	9-8-59	S
Do	42	18-79	9-21-59	S
Do	4	17-116	10-6-59	S
Do	2	42	10-20-59	S
East Beach, St. Simons Island, Ga.	8	14-44	8-11-53	S
Do	23	14-38	5-28-56	S
Do	3	27.2-35	6-11-56	S
Do	2	14	4-16-57	S
Do	1	51	7-9-59	S
Jekyll Island Beach, Ga.	50	12-110	7-11-56	S
Do	42	16-71	7-19-56	S

[1] See footnote at end of table.

APPENDIX TABLE 1.—*Specimens examined, by species and collection*—Continued

Collection [1]	Number of specimens	Size (mm.)	Date of capture	Gear used
T. carolinus—Cont.				
Jekyll Island Beach, Ga.	46	15-56	10-5-56	S
Do	1	12	4-16-57	S
Do	85	22-55	10-19-57	S
Do	10	13-19	4-27-59	S
Do	300	14-91	8-7-59	S
Do	29	11-66	9-8-59	S
Sapelo Beach, Sapelo Island, Ga.	1	82.5	6-10-53	S?
Commercial trawling area, Brunswick, Ga.	1	143	5-2-54	T
Do	1	101	8-17-55	T
Do	1	209	7-4-56	T
Do	1	190	7-17/20-56	T
Do	2	136.5, 150.5	7-23/24-56	T
Do	1	195	7-27-56	T
Do	4	133-160	7-31-56	T
Do	6	139-197	9-23-56	T
Do	1	165.5	3-29-57	T
Do	2	160, 166	10-22-58	T
Fort Walton Beach (Gulfarium), Okaloosa County, Fla.	2	262, 316	Spring, 1958	—
Port Canaveral, Brevard County, Fla.	1	12.1	4-28/29-57	DN
Gill cruise 3, Reg. Sta. 42 (31°57′ N., 79°16′ W.)	1	7.2	8-5-53	P
Gill cruise 8 Reg. Sta. 47 (32°40′ N., 79°00′ W.)	1	11.0	9-25-54	DN
Phillips. Beach at Marineland, St. Johns County, Fla.	7	10.1-16.7	8-12-56	S?
UF 5559. Commercial trawling area, Brunswick, Ga.	1	166.5	10-23-55	T
Inst. Jam. Kingston Harbour, Jamaica, British West Indies	1	283	6-25-57	—
ChM 31.207.3. Capers Inlet, Charleston County, S.C.	2	115, 122	9-10-31	—
Commercial catch. Indian R., Brevard County, Fla.	10	236-284	8-19-58	C
Do	20	243-341	8-20-58	C
T. falcatus:				
BLBG:				
King and Prince Beach, St. Simons Island, Ga.	2	18, 27	7-21-53	S
Do	1	14	8-26-53	S
Do	1	18	9-9-53	S
Do	5	17-20	8-6-54	S
Do	1	46.4	9-1-54	S
Do	26	18-33	10-29-54	S
Do	2	24, 28	7-22-55	S
Do	1	18	8-5-55	S
Do	15	16-23	9-6-55	S
Do	23	13-30	9-19-55	S
Do	10	18-30	10-5-55	S
Do	59	14-52	10-14-55	S
Do	4	19-34	11-3-55	S
Do	5	34-46	11-16-55	S
Do	1	22	6-11-56	S
Do	2	21, 22	6-26-56	S
Do	4	30-36	7-10-56	S
Do	1	20	7-24-56	S
Do	1	14	8-24-56	S
Do	29	12-56	9-7-56	S
Do	15	16-49	9-27-56	S
Do	4	14-22	10-23-56	S
Do	15	27-44	5-31-57	S
Do	14	24-50	6-14-57	S
Do	3	35-47	7-1-57	S
Do	7	24-31	7-9-57	S
Do	12	23-53	7-15-57	S
Do	7	21-43	7-29-57	S
Do	7	16-51	8-13-57	S
Do	12	18-51	8-27-57	S
Do	71	13-33	9-7-57	S
Do	4	21-41	9-11-57	S
Do	7	15-36	9-26-57	S
Do	79	13-102	10-11-57	S
Do	7	18-45	10-25-57	S
Do	1	18	6-4-58	S
Do	1	26	6-20-58	S
Do	2	32, 46	7-3-58	S
Do	23	15-54	8-18-58	S
Do	8	22-51	10-2-58	S
Do	15	13-65	10-16-58	S
Do	4	18-45	11-14-58	S
Do	9	20-28	6-9-59	S
Do	3	15-24	6-23-59	S

PPENDIX TABLE 1.—*Specimens examined, by species and collection*—Continued

Collection [1]	Number of specimens	Size (mm.)	Date of capture	Gear used
falcatus—Con.				
BLBG:				
King and Prince Beach, St. Simons Island, Ga.	4	48–59	7–23–59	S
Do	8	20–66	8–21–59	S
Do	22	23–89	9–21–59	S
Do	19	14–42	10–6–59	S
Do	1	18	11–6–59	S
East Beach, St. Simons Island, Ga.	1	20	5–28–56	S
Do	1	21	6–11–56	S
Do	2	20, 33	7–29–57	S
Do	3	27–29	7–21–58	S
Do	4	23–70	8–18–58	S
Do	40	19–57	9–2–58	S
Do	11	23–29	10–2–58	S
Do	2	37–55	11–3–58	S
Do	2	30	7–9–59	S
Do	1	16	9–8–59	S
Causeway between Jekyll Island and Brunswick, Ga.	1	17.7	10–11 57	S
Do	1	32	7–9–59	S
Jekyll Island Beach, Ga.	1	21	10–5–56	S
Do	1	24	10–19–57	S
Lewis Crab Co., Brunswick, Ga. (no data).	3	154. 5–182	5–59	------
Gill cruise 2, Reg. Sta. 40 (31°29′ N., 78°41′ W.).	1	7.7	5–5–53	DN
Gill cruise 3, Reg. Sta. 42 (31°57′ N., 79°16′ W.).	1	7.3	8–5–53	P
Gill cruise 3, Reg. Sta. 50 (31°57′ N., 78°09′ W.).	1	7.3	8–6–53	P
Gill cruise 3, Reg. Sta. 63 (33°24′ N., 76°25′ W.).	1	5.0	8–11–53	P
BLBG(MI):				
Little River, 1 mile NE Calabash, N.C.	1	59.5	7–21–56	S?
Great Egg Harbor, N.J.	1	24.1	10–6–56	S?
Indian River, Sebastian, Fla.	12	17.9–46.6	11–7–56	S?
USNM 49635: Woods Hole, Mass.	4	20.2–33.6	8–14–99	------
USNM 143935: Katama Bay, Mass.	2	17.7, 20.6	7–27–15	------
USNM 67890: Bay near Ocean View, Va.	1	64.5	9–98	------
USNM 74292: Cape Lookout, N.C.	1	44.9	7–12	------
USNM 111763: Fort Macon, N.C.	1	27.3	6–30–32	------
USNM 122646: Port au Prince market, Haiti.	1	172	1943	------
USNM 50126: Mayaguez, Porto Rico.	1	132	1–19–99	------
USNM 73745: Do	3	26.4–42.9	1–19–99	------
USNM 111762: Key West, Fla., near Slaughter House.	4(of 15)	17–84	10–13–19	------
USNM 26585: Key West, Fla.	1	216.5	1880	------
USNM 125517: Tampa market, Fla.	1	125.5	11–7–96	------
USNM 26596: Cedar Key, Fla.	1	63.5	1880	------
USNM 185075: Do	1	42.1	10–12–47	------
USNM 116840: Tortugas, Fla.	3	32.5–64.5	----------	------
USNM 143940: Oso bridge, Corpus Christi Bay, Tex.	1	133.5	8–26–26	------
USNM 143939: Corpus Christi, Tex.	2	26.1, 35.6	10–14/29–26	------
USNM 80100: Fox Bay, Panama.	3	32.2–42.5	1–3–11	------
USNM 44703: Central America (probably from Atlantic).	1	127.5	1893	------
USNM 76319: Porto Seguiro, Brazil.	2	74, 85	----------	------
UF C–6–1256–1: Plantation Key, Monroe County, Fla.	3	12.3–15.7	6–12–56	------
Inst. Jam.: Lazaretto Cairn, Jamaica, near Kingston.	1	57.0	6–16–57	------
ChM 31.267: Mount Pleasant, E. Frampton, S.C.	1	136.5	11–11–31	------
ChM 31.207.12: Capers Inlet, S.C.	15	21–48.9	9–10–31	------
UG 378: Sapelo Island, Ga.	1	85.5	9–4–54	------
BU: M/V *Delaware* (37°30′ N; 68°10′ W.).	1	11.7	7–11–57	DN

APPENDIX TABLE 1.—*Specimens examined, by species and collection*—Continued

Collection [1]	Number of specimens	Size (mm.)	Date of capture	Gear used
T. falcatus—Con.				
Phillips:				
Fort Pierce, Fla.	40	9.8–28.6	8–29–55	------
Do	45	23–66.5	10–8–55	------
Bahia Honda, Fla.	4	76–103	4–15–56	------
Marineland Beach, Fla.	1	38.1	8–12–56	------
Largo Sound, Fla.	35	18.4–46.6	7–15–56	------
Marco Beach, Fla.	1	89.5	7–16–56	------
Crandon Park, Miami, Fla.	4	9.1–18.8	5–24–57	------
Do	1	9.3	7–9–57	------
Do	2	8.5, 9	5–1–56	------
Do	4	8.3–9.5	6–12–56	------
Do	2	10.4, 10.7	1–28–57	------
Do	32	7.2–10.6	2–7–57	------
Do	14	6.7–11.1	2–8–57	------
Do	5	8.5–11.5	4–1–57	------
Do	11	6.7–11.5	4–24–57	------
Do	2	9.9, 10	5–1–57	------
Do	3	6.4–9.8	9–1–57	------
Do	1	8.9	9–2–57	------
Do	1	7.6	4–15–58	------
Bear Cut, Miami, Fla.	1	7.6	8–17–54	------
Do	1	11.3	3–23–57	------
Virginia Key, Miami, Fla.	1	8.1	9–17–54	------
Vero Beach, Fla.	1	7.9	7–21–56	------
Do	1	8.9	7–25–56	------
Do	1	8.4	7–31–56	------
Do	9	6.4–12.1	8–12–56	------
Do	1	8.9	8–14–56	------
T. glaucus;				
BLBG:				
King and Prince Beach, St. Simons Island, Ga.	1	28.9	10–29–54	S
Do	2	35.8, 39.4	9–7–56	S
Do	2	23.9, 24	9–27–56	S
Do	1	23.3	11–20–56	S
Do	3	48.5–61	10–11–57	S
Do	1	19.4	10–25–57	S
Do	1	26.2	11–14–58	S
Do	1	60.0	8–7–59	S
UF (uncataloged):				
Open Gulf beach, 5 km. south Veracruz, Mocambo, Mexico.	4	76.5–124	1–20/21–58	------
Beach 5 miles W. Nassau, New Providence Island, Bahamas.	21	16.6–110	7–5–58	------
Do	1	128	8–11–56	------
UF 5908:				
Flagler Beach, Flagler County, Fla.	7	36–50.5	10–2–56	------
Inst. Jam.:				
Lucea, Jamaica	1	211	9–30–51	------
Kingston market, Jamaica	1	141.5	4–24–59	------
ChM:				
Old Collection; S.C.	1 (of 2).	139	----------	------
Phillips:				
Bahia Honda Key, Fla.	5	71.5–89	4–15–56	S
Crandon Park, Miami, Fla.	1	11.8	2–8–57	------
Seaquarium Boat Dock, Miami, Fla.	1	7.8	2–8–58	------
USNM 125672. Buzzards Bay, Mass.	1	65	9–22–97	------
USNM 62699. St. Augustine, Fla.	4	35.3–45.5	11–18–08	------
USNM 50100. Aquadilla, Porto Rico.	1	110	----------	------
USNM 73744. Mayaguez, Puerto Rico.	1	42.4	1–20–99	------
USNM 111767. Key West, Fla.	1	40.5	10–13–19	------
USNM 68595. Dry Tortugas, Fla.	1	63	----------	------
USNM 61127. Tortugas, Fla.	4	40–45	----------	------
USNM 143952. Tortugas, Fla.	2	43, 65	11–25–19	------
USNM 143953. Louisiana	1	14.6	----------	------
USNM 143954. Aransas Pass, Tex.	4	73–88	10–2/11–26	------
USNM 123068. Cape San Roman, Gulf of Venezuela.	3	24.7–85	4–2–25	------

[1] Abbreviations explained, page 189.

APPENDIX TABLE 2.—*Measurements of selected body proportions for* Trachinotus *spp., expressed as percent of standard length*

Standard length (mm.)	Percent of standard length									
				Dorsal fin		Anal fin				
	Head length	Eye diameter	Body depth	Lobe length	Base length	Lobe length	Base length	Pectoral fin length	Pelvic-fin length	Caudal-fin lobe length
Trachinotus sp.										
3.07	39.1	11.0	18.2	------	------	------	------	------	------	------
4.0	41.5	13.2	19.2	------	------	------	------	------	------	------
4.66	33.8	11.2	20.2	------	------	------	------	------	------	------
T. carolinus:										
7.2	39.5	13.1	32.0	------	41.4	------	26.9	18.9	9.7	------
10.1	38.8	13.5	32.0	------	46.3	------	32.8	24.4	12.5	32.8
10.3	37.0	13.5	31.7	------	46.7	------	30.2	22.8	14.5	33.5
10.6	37.9	13.1	30.5	------	43.2	------	31.4	24.5	14.7	32.9
11.0	37.0	12.7	34.7	17.1	46.4	------	29.2	20.6	15.1	33.5
11.1	37.0	12.1	39.0	------	43.6	------	32.2	20.9	16.1	33.2
11.5	37.2	12.4	33.8	------	46.0	------	30.5	23.0	13.6	33.9
11.8	36.5	12.4	30.1	19.4	45.0	------	30.2	20.9	13.5	33.0
11.8	35.6	12.4	28.7	------	45.0	20.8	29.5	20.1	15.6	33.0
12.0	38.0	13.3	34.7	------	45.8	18.8	29.9	21.3	17.1	33.2
12.1	39.8	12.8	33.2	19.8	43.8	17.6	29.9	21.4	13.7	34.0
13.0	35.9	12.2	32.6	18.3	45.4	17.4	30.8	21.2	14.9	33.0
13.2	37.9	12.5	31.6	19.9	46.2	18.6	29.6	23.6	15.9	33.4
14.1	36.2	12.4	31.4	17.5	43.3	17.4	29.8	20.9	14.9	33.2
15.8	35.4	11.7	33.6	19.1	46.8	18.2	31.6	21.9	15.6	31.6
16.7	37.8	12.1	34.1	20.4	47.3	18.3	31.7	21.8	16.3	32.9
18.9	35.4	10.8	33.9	20.4	47.1	19.0	30.6	------	15.6	32.8
21.6	37.5	10.4	35.2	20.2	45.9	19.9	29.6	19.9	15.9	32.4
24.6	35.4	10.1	35.8	20.0	47.2	19.2	30.1	20.7	16.0	31.3
25.7	------	------	32.7	21.0	------	20.6	------	19.1	17.1	34.2
27.2	32.4	9.5	38.2	21.4	49.7	19.9	32.7	19.1	14.7	33.1
29.3	33.2	10.2	31.4	22.1	46.5	21.2	30.0	20.8	18.5	33.8
30.6	------	------	38.0	21.2	------	22.3	------	20.3	17.3	35.3
31.3	------	------	34.9	19.8	------	20.8	------	19.5	15.7	34.6
31.7	31.9	8.2	35.7	21.4	45.2	20.5	30.3	21.1	16.8	31.6
31.9	------	------	36.7	22.6	------	22.0	------	21.0	16.3	35.4
33.2	------	------	35.6	21.7	------	22.3	------	21.4	19.3	34.7
33.5	30.5	9.8	33.7	22.7	48.4	21.5	31.4	20.6	15.8	33.8
33.7	------	------	34.7	22.8	------	23.4	------	21.0	17.2	------
35.5	32.7	9.7	41.1	21.0	49.0	20.9	33.5	17.2	14.4	31.8
37.4	------	------	35.6	22.7	------	24.0	------	21.7	16.9	34.5
37.5	------	------	40.0	------	------	22.7	------	21.4	15.2	35.8
38.0	31.3	9.7	34.8	21.3	50.0	21.8	33.2	20.5	------	33.2
40.0	33.0	9.3	40.3	25.3	50.5	20.2	34.5	20.2	16.2	31.5
40.0	------	------	44.3	21.2	------	24.5	------	22.3	14.5	37.5
42.1	30.6	8.9	38.3	22.6	50.4	21.4	33.4	21.4	14.7	34.2
43.9	------	------	39.4	25.8	------	23.0	------	22.4	16.4	38.7
44.0	------	------	40.5	26.2	------	25.0	------	21.8	17.8	36.4
44.0	------	------	37.8	22.8	------	20.7	------	20.9	17.3	34.0
45.1	35.5	10.2	36.2	24.2	47.6	21.0	32.8	21.3	18.6	33.9
46.4	------	------	37.5	23.6	------	21.6	------	25.0	16.8	38.4
47.4	------	------	40.6	25.4	------	23.2	------	23.4	17.1	38.6
48.3	32.2	9.3	40.0	23.4	------	21.8	36.5	20.5	15.7	37.9
50.0	------	------	40.8	25.6	------	24.0	------	20.0	16.8	36.0
51.0	------	------	39.4	24.9	------	23.7	------	23.0	16.7	36.7
52.0	31.6	9.3	43.5	24.2	53.5	22.8	36.9	24.6	14.8	34.2
53.5	------	------	35.4	23.0	------	22.0	------	20.9	15.7	35.5
55.5	------	------	38.0	25.6	------	22.7	------	21.3	16.8	35.2
56.0	------	------	41.6	23.6	------	25.0	------	22.4	17.2	37.5
56.5	32.4	10.1	37.7	24.0	50.6	22.6	34.3	22.0	16.3	36.3
58.5	------	------	44.0	27.9	------	25.8	------	24.0	17.8	40.2
59.0	------	------	39.9	24.3	------	22.2	------	20.9	15.8	35.4
61.5	------	------	43.4	23.9	------	23.7	------	22.5	16.4	39.6
63.5	32.8	9.8	46.9	26.8	53.7	25.0	38.3	24.4	18.4	39.2
64.0	------	------	41.0	23.8	------	21.7	------	20.8	16.9	32.7
65.0	------	------	38.5	24.0	------	23.4	------	21.6	15.7	36.5
66.0	------	------	39.5	23.8	------	24.0	------	21.7	17.2	37.6
67.0	------	------	39.9	25.0	------	22.8	------	21.4	16.0	37.6
67.5	------	------	40.6	24.9	------	22.5	------	21.0	15.3	37.0
68.0	------	------	39.6	24.7	------	22.6	------	21.0	16.2	36.5
68.5	31.4	8.6	41.7	26.4	51.4	24.2	36.3	23.8	15.5	38.0
69.0	------	------	42.2	25.4	------	22.4	------	21.3	16.0	36.0
69.5	------	------	42.3	25.3	------	23.4	------	21.3	16.7	36.4
72.5	------	------	42.6	27.6	------	24.7	------	23.3	16.0	38.2
74.5	------	------	41.8	25.1	------	22.8	------	21.6	15.8	35.8
77.5	31.9	9.2	46.2	27.1	55.0	23.4	38.6	25.3	14.1	39.7
77.5	------	------	48.5	28.2	------	25.2	------	24.2	15.7	------
82.5	30.7	7.8	46.2	24.9	52.5	24.6	38.6	22.2	14.0	35.2
83.5	------	------	42.8	24.3	------	23.8	------	21.4	15.5	38.1
84.5	------	------	46.0	24.3	------	24.0	------	22.4	15.5	36.2
85.5	------	------	42.8	24.2	------	22.8	------	21.0	14.8	35.9
88.0	30.3	9.9	45.9	27.4	54.7	29.9	38.8	26.3	16.6	40.6
91.0	------	------	42.5	26.8	------	23.6	------	22.5	15.8	37.6
91.0	------	------	41.7	26.8	------	23.2	------	22.5	15.9	36.6
91.5	------	------	42.7	27.4	------	23.8	------	22.8	15.4	39.8
91.5	------	------	42.6	24.6	------	23.8	------	22.8	15.2	38.2
93.0	------	------	41.9	24.6	------	22.6	------	23.4	15.6	38.0
96.5	31.3	8.0	46.8	25.2	54.0	24.1	38.0	24.0	14.7	37.8

APPENDIX TABLE 2.—*Measurements of selected body proportions for* Trachinotus *spp., expressed as percent of standard length* —Continued

Standard length (mm.)	Percent of standard length									
				Dorsal fin		Anal fin				
	Head length	Eye diameter	Body depth	Lobe length	Base length	Lobe length	Base length	Pectoral fin length	Pelvic-fin length	Caudal-fin lobe length
T. carolinus—Con.										
99.0	------	------	44.1	26.3	------	24.2	------	23.4	14.9	36.2
101.0	31.4	8.2	48.7	27.0	54.5	23.6	40.0	24.4	15.0	41.4
108.5	31.2	8.1	48.0	25.7	53.0	24.6	39.8	24.7	17.6	38.6
115.0	28.8	7.9	49.6	27.9	54.0	25.8	40.5	23.6	13.8	------
119.5	------	------	46.3	26.2	------	23.3	------	23.6	14.3	37.4
122.0	27.6	7.0	50.0	29.1	55.8	------	40.0	23.9	15.0	39.9
127.5	27.7	6.7	47.8	23.9	56.1	24.9	41.6	24.0	15.6	38.6
133.0	27.9	6.6	47.4	27.1	55.3	25.5	39.1	23.4	------	38.4
136.5	27.8	6.7	46.8	30.0	54.6	22.3	41.4	22.0	13.5	35.9
139.0	28.2	7.2	49.6	28.8	56.9	25.0	41.4	25.3	14.5	42.0
143.0	28.3	6.9	49.3	27.4	55.3	24.0	40.2	24.6	13.5	42.3
144.0	28.6	------	48.7	24.7	54.5	24.4	40.3	23.4	13.2	37.0
148.0	------	------	45.7	25.4	------	23.4	------	22.4	12.6	37.7
149.0	------	6.4	46.9	23.4	------	23.3	------	22.6	13.1	37.8
150.5	26.3	6.6	46.8	28.6	56.9	23.6	41.2	22.4	14.3	39.0
157.0	26.6	6.6	45.8	28.5	56.1	25.6	42.0	25.1	12.9	38.2
158.0	27.0	6.7	47.5	25.9	55.7	26.0	41.2	23.7	13.5	38.9
160.0	25.4	5.7	45.6	25.4	55.7	25.6	39.4	23.8	13.1	36.8
160.0	28.0	7.4	46.9	26.0	55.0	24.8	39.4	23.5	13.7	40.0
165.5	25.4	6.5	45.3	26.6	56.3	23.1	41.0	24.4	14.4	41.7
166.0	28.6	7.4	46.7	30.7	54.9	28.1	38.0	24.9	13.7	41.0
166.5	28.6	8.0	49.3	23.7	54.7	23.0	40.8	23.3	14.0	38.1
177.0	25.2	5.9	49.4	26.3	58.0	24.5	40.5	23.8	11.8	39.5
182.0	25.6	6.0	55.0	27.3	57.0	25.5	41.2	24.0	13.5	40.7
183.5	26.6	6.3	46.9	27.0	56.8	24.8	39.8	23.6	13.1	40.0
190.0	26.0	6.0	46.3	25.6	56.9	24.2	41.0	24.4	13.5	41.8
195.0	28.8	7.1	45.1	24.7	54.0	27.4	38.7	25.0	12.5	------
197.0	26.3	6.2	50.3	25.4	56.4	24.2	39.6	23.2	12.6	38.0
209.0	27.2	6.7	44.5	26.6	56.8	23.8	40.5	23.2	13.3	40.6
236.0	26.7	6.8	44.5	30.5	------	25.8	------	25.4	12.3	41.5
240.0	26.0	6.8	44.6	25.0	------	23.0	------	24.2	11.6	42.5
240.0	25.2	6.4	44.2	28.8	------	23.6	------	22.9	11.6	42.1
243.0	25.7	6.3	44.9	25.9	------	21.6	------	23.4	11.5	40.3
243.0	25.9	------	47.0	29.6	------	25.3	------	24.4	11.9	40.6
248.0	26.0	7.3	46.4	27.6	------	25.0	------	24.2	12.5	46.5
248.0	25.6	------	45.2	29.9	------	24.8	------	24.0	11.5	40.7
251.0	25.5	------	45.3	31.0	------	26.3	------	25.5	12.1	42.3
252.0	25.4	------	45.7	27.8	------	24.8	------	25.0	12.1	45.6
261.0	25.6	------	44.1	28.6	------	24.0	------	23.8	11.6	41.7
262.0	26.7	6.0	45.4	26.3	57.3	24.4	41.7	22.9	11.0	43.7
264.0	25.2	6.0	44.3	26.2	------	26.2	------	23.3	11.9	40.4
264.0	26.5	------	44.0	26.9	------	23.3	------	23.3	12.2	44.3
267.0	24.7	------	43.7	27.7	------	23.6	------	23.8	11.7	------
270.0	25.6	------	49.3	24.1	------	23.7	------	23.5	11.5	39.9
272.0	25.9	------	46.9	24.8	------	23.5	------	23.2	11.0	39.0
277.0	24.4	6.5	43.0	24.2	------	23.8	------	23.8	11.6	40.8
277.0	25.1	------	40.8	27.0	------	24.0	------	23.1	11.9	40.0
278.0	23.8	------	44.6	23.2	------	21.8	------	23.0	11.5	39.6
280.0	25.7	------	42.8	26.8	------	23.6	------	23.9	11.4	39.4
280.0	23.9	------	44.6	26.8	------	26.4	------	22.8	11.2	40.6
281.0	24.8	------	43.3	26.3	------	24.9	------	23.8	11.5	41.7
283.0	28.8	7.6	43.0	28.8	54.0	26.5	40.2	25.8	12.7	40.7
284.0	25.0	------	45.4	25.5	------	22.5	------	22.0	10.7	39.9
292.0	25.0	------	42.5	25.3	------	23.0	------	22.8	11.0	40.0
294.0	24.5	------	43.2	26.7	------	21.4	------	23.0	10.8	39.6
297.0	------	------	39.6	20.9	------	21.6	------	22.6	10.9	38.4
297.0	24.8	------	42.4	25.6	------	23.6	------	22.6	10.8	40.0
310.0	24.5	6.5	42.6	25.5	------	22.4	------	23.0	11.0	38.8
310.0	24.8	5.5	42.6	24.8	------	24.7	------	22.9	10.2	38.4
316.0	24.8	5.9	39.7	------	54.9	------	37.4	20.7	10.3	34.0
324.0	24.7	5.3	44.7	23.2	------	21.6	------	23.0	10.9	38.0
341.0	23.5	------	39.6	22.0	------	20.5	------	19.6	10.0	35.8
T. falcatus:										
5.0	41.8	15.8	30.4	------	42.0	------	24.0	13.0	------	24.6
6.7	39.0	14.3	32.9	------	42.7	------	29.6	------	5.4	------
7.3	42.4	14.4	36.0	------	44.8	------	31.0	21.5	6.3	------
7.3	43.6	15.0	35.4	------	43.6	------	29.0	17.0	7.9	------
7.3	38.5	15.5	39.4	------	42.0	------	28.1	------	8.1	------
7.3	38.0	14.0	40.5	------	37.7	------	29.2	------	10.4	------
7.7	43.2	16.4	44.2	------	47.9	------	29.0	------	10.0	35.2
9.0	39.5	14.8	37.0	------	43.9	------	30.2	------	9.7	------
9.8	39.0	13.9	39.8	17.4	------	18.2	------	22.6	11.2	31.2
10.7	------	------	40.5	18.2	------	19.1	------	23.8	14.3	33.3
10.9	37.3	12.5	42.0	21.0	------	19.4	------	23.8	14.0	35.0
11.1	39.0	13.7	44.3	20.8	46.0	19.0	31.4	23.3	12.0	34.6
11.3	36.8	12.7	42.0	19.5	------	18.9	------	21.8	14.2	33.8
11.5	39.8	12.5	42.8	18.4	------	17.0	------	22.9	13.3	34.7
11.7	42.8	15.2	40.6	20.4	------	21.8	------	23.9	15.2	34.1
12.1	38.6	12.6	41.5	19.7	------	17.5	------	22.5	11.9	33.6
12.1	37.2	12.6	46.2	------	------	18.3	------	20.3	13.3	35.8
12.5	38.7	13.6	48.8	18.3	------	19.1	------	23.8	14.2	35.3
12.6	40.5	14.1	46.0	20.9	------	20.2	------	24.3	15.5	37.1

PPENDIX TABLE 2.—*Measurements of selected body proportions for* Trachinotus *spp., expressed as percent of standard length*—Continued

andard ength mm.)	Percent of standard length									
	Head length	Eye diameter	Body depth	Dorsal fin		Anal fin		Pectoral fin length	Pelvic-fin length	Caudal-fin lobe length
				Lobe length	Base length	Lobe length	Base length			
falca-tus— Con.										
2.7	37.4	13.4	41.7	------	------	18.7	------	24.1	14.0	35.4
2.8	41.4	13.9	46.9	20.5	------	21.2	------	23.9	13.9	35.2
3.1	39.7	13.0	48.1	18.8	------	19.5	------	23.4	14.9	32.4
3.2	40.2	14.2	47.0	19.3	------	19.3	------	23.8	13.5	34.1
3.3	40.6	13.4	40.0	19.8	------	19.2	------	21.7	16.6	33.8
3.5	38.5	13.9	48.8	21.4	------	21.4	------	23.9	15.1	34.6
3.6	36.4	12.5	------	16.5	47.8	18.2	33.3	21.8	15.6	31.1
3.6	38.9	12.4	47.0	19.3	------	20.6	------	23.1	14.5	34.9
3.7	40.1	13.7	48.2	19.2	------	19.8	------	22.9	14.9	34.1
3.9	38.2	12.8	48.2	22.0	------	20.1	------	24.4	14.7	34.8
4.0	37.8	12.7	42.9	19.4	------	20.0	------	23.1	13.9	33.9
4.6	41.1	15.1	50.0	19.2	------	21.0	------	24.4	15.7	33.7
4.8	39.2	13.2	44.6	20.0	------	20.0	------	23.5	17.2	34.5
4.8	40.6	14.3	52.0	19.5	------	18.4	------	23.5	14.9	34.5
5.2	38.2	13.4	44.8	21.8	------	21.2	------	24.5	15.7	34.9
5.2	40.2	13.9	53.3	20.6	------	21.8	------	22.9	15.7	36.8
5.3	38.6	12.2	49.0	21.6	------	20.0	------	23.3	14.4	34.6
5.4	40.3	13.4	51.3	21.2	49.3	22.0	36.4	24.4	16.6	35.1
5.4	38.9	14.7	41.5	21.0	------	19.9	------	24.2	16.0	35.1
5.5	38.7	14.4	48.4	19.8	47.0	20.0	33.5	24.2	15.9	34.8
5.6	41.0	13.6	53.9	20.7	------	20.7	------	23.9	15.8	36.5
5.9	------	------	52.7	19.2	------	20.3	------	23.5	15.0	34.0
6.2	38.9	13.1	50.0	22.0	------	21.4	------	24.6	16.2	36.4
6.5	37.6	12.4	50.3	20.0	------	20.0	------	23.2	14.9	33.9
6.5	37.6	13.4	49.7	20.0	------	20.0	------	23.2	14.4	33.3
6.8	38.6	12.6	44.0	18.7	------	20.4	------	23.2	16.7	33.9
7.0	40.0	14.6	47.0	22.0	48.8	19.0	34.7	24.5	12.4	35.9
7.1	38.5	12.9	51.0	19.8	------	19.8	------	22.8	15.9	33.9
7.3	37.5	12.8	43.4	19.1	------	19.6	------	23.5	15.7	34.1
7.4	35.0	11.7	45.4	20.4	------	20.0	------	22.0	15.1	33.9
7.5	40.6	13.1	46.8	21.8	------	19.9	------	22.8	18.5	34.3
7.5	37.6	13.6	50.3	20.3	------	19.9	------	23.8	16.0	33.1
7.7	39.6	13.3	52.5	18.2	49.7	18.8	37.3	22.6	15.5	37.3
7.7	39.0	13.9	55.4	22.5	50.3	22.5	37.3	25.4	15.4	33.3
7.9	39.1	14.2	52.5	21.3	------	22.8	------	24.2	16.1	36.3
7.9	38.5	14.7	45.8	23.2	------	------	------	23.7	15.6	35.8
8.2	40.1	14.3	44.5	22.5	47.8	21.8	34.6	24.5	16.2	34.6
8.4	34.2	12.4	34.2	19.8	------	18.9	------	21.2	15.2	31.5
8.5	39.5	11.9	42.7	19.7	------	19.2	------	23.4	15.1	34.6
8.8	35.6	14.9	52.1	20.7	50.0	22.1	37.8	23.2	16.7	33.0
8.8	40.9	12.9	53.1	21.6	------	21.7	------	23.9	14.6	34.6
9.0	40.0	13.4	50.5	20.5	------	20.5	------	22.8	16.1	35.3
9.2	36.4	12.4	44.7	19.9	------	19.0	------	22.1	14.2	33.3
9.6	39.8	12.1	45.4	19.9	------	19.5	------	21.4	16.5	32.7
9.6	35.2	13.0	43.4	20.8	------	20.4	------	22.1	15.6	34.2
9.7	37.5	13.8	54.3	18.9	------	21.1	------	25.0	16.4	35.5
0.1	37.3	13.5	52.7	21.0	------	20.2	------	23.2	15.2	34.8
0.5	35.6	11.6	45.9	19.5	------	21.1	------	23.2	16.1	33.7
0.6	36.9	13.6	58.8	22.8	52.0	21.0	37.8	23.1	16.5	29.1
0.9	37.3	13.8	52.6	------	51.8	20.7	38.7	17.8	13.4	36.4
1.0	35.2	12.4	48.6	20.2	49.1	21.6	36.2	23.4	16.0	34.8
1.2	33.5	11.2	43.9	20.0	------	19.5	------	21.2	14.8	31.6
1.4	39.2	14.3	58.5	23.8	------	24.8	------	23.4	15.5	37.9
1.4	37.3	12.3	46.2	19.8	------	19.8	------	21.8	15.8	34.6
1.5	37.7	13.8	51.2	20.4	------	20.9	------	23.7	16.2	34.4
1.8	39.0	14.0	52.8	23.8	------	23.8	------	23.9	17.1	37.2
2.0	34.5	12.0	51.0	19.2	------	21.2	------	24.5	16.2	36.4
2.7	36.6	13.1	53.0	20.2	------	20.2	------	22.9	15.7	33.9
2.7	36.1	12.0	45.9	20.9	------	20.6	------	24.2	15.3	35.2
2.8	35.5	12.8	54.0	25.4	50.5	24.5	38.2	24.1	19.2	34.6
2.9	37.5	13.7	53.8	23.2	------	23.1	------	24.0	15.9	36.7
3.3	37.7	12.7	48.5	24.0	50.8	23.6	37.4	22.3	16.5	35.6
3.4	36.7	12.0	57.8	22.8	------	21.8	------	25.2	15.6	37.6
3.4	37.2	13.4	45.0	21.0	------	20.9	------	22.2	16.7	35.0
3.6	36.0	12.2	46.7	21.6	------	21.2	------	23.3	16.2	34.3
3.7	37.2	12.2	56.1	21.5	------	22.8	------	23.6	15.0	34.2
3.8	34.0	11.4	45.8	20.6	------	19.9	------	21.4	14.6	33.2
4.3	37.0	11.5	58.0	22.6	52.8	19.5	38.7	25.9	14.7	39.1
4.3	35.8	14.6	49.0	21.0	------	21.4	------	21.4	16.4	31.7
4.6	33.3	10.8	51.2	22.4	53.3	20.7	38.6	22.4	16.7	36.6
5.1	37.1	12.9	47.4	21.5	------	21.9	------	23.5	14.9	35.1
6.1	34.0	11.1	58.3	22.6	52.5	20.3	38.7	22.6	14.0	34.5
6.1	33.3	11.1	52.5	19.8	------	22.2	------	21.8	15.6	33.3
6.1	33.3	11.7	46.4	20.3	------	22.6	------	20.3	15.3	33.0
6.2	35.5	12.0	44.0	22.9	------	21.8	------	22.5	15.9	33.6
6.4	35.2	12.4	49.7	22.0	50.0	22.7	36.8	23.1	16.1	35.2
6.4	35.9	12.8	51.2	24.6	50.0	------	35.6	24.2	15.4	38.6
6.4	34.8	12.6	51.9	21.6	------	22.3	------	24.2	12.9	34.1
6.4	37.1	13.8	59.5	24.2	------	23.0	------	22.3	18.0	37.5
6.5	32.8	10.9	47.6	20.0	------	19.2	------	22.3	14.7	32.5
6.9	32.0	11.0	47.6	20.8	------	20.4	------	21.2	15.1	33.1
7.2	37.9	12.8	54.5	22.4	------	22.4	------	23.5	17.5	36.0

APPENDIX TABLE 2.—*Measurements of selected body proportions for* Trachinotus *spp., expressed as percent of standard length*—Continued

Standard length (mm.)	Percent of standard length									
	Head length	Eye diameter	Body depth	Dorsal fin		Anal fin		Pectoral fin length	Pelvic-fin length	Caudal-fin lobe length
				Lobe length	Base length	Lobe length	Base length			
T. falca-tus— Con.										
27.2	33.4	12.5	51.5	22.0	------	22.0	------	21.7	15.9	33.5
27.2	37.5	11.3	46.3	24.6	------	25.7	------	25.4	15.6	38.2
27.3	35.8	12.4	60.9	22.4	55.4	23.4	41.4	22.0	15.9	34.1
27.6	36.2	12.3	47.1	19.6	------	20.3	------	23.2	14.5	32.2
28.0	34.2	10.9	47.2	20.7	------	20.3	------	21.1	14.9	33.6
28.6	33.5	11.0	47.6	20.3	------	19.2	------	20.3	14.8	31.5
28.8	34.8	11.5	52.9	22.6	50.8	20.8	39.3	22.6	14.0	37.2
28.9	35.0	11.4	44.0	20.4	------	19.4	------	20.8	15.8	33.6
28.9	35.0	12.3	45.7	21.1	------	20.8	------	21.5	14.4	33.6
29.2	35.6	11.9	60.4	24.3	52.8	21.6	40.4	23.6	16.0	37.0
29.2	37.4	13.7	47.0	22.2	------	------	------	24.0	16.3	33.6
29.4	32.6	10.4	48.6	20.0	------	20.4	------	21.1	14.7	31.6
29.6	35.2	12.6	58.8	24.4	------	23.3	------	------	15.2	37.2
29.6	34.5	12.0	47.3	21.2	------	21.6	------	23.3	14.9	35.1
30.5	35.1	11.5	49.5	22.3	49.9	22.6	37.4	22.6	13.9	35.1
31.2	35.3	11.4	46.5	20.5	------	20.8	------	21.5	15.5	32.7
32.2	33.6	12.4	56.5	------	52.0	21.4	39.8	21.1	15.0	35.4
32.4	33.4	11.0	49.1	23.4	50.3	22.8	38.0	21.7	17.3	37.0
32.5	33.9	12.3	47.1	23.7	51.5	22.4	36.4	22.2	15.4	36.0
32.5	36.1	12.3	46.8	23.0	------	23.6	------	23.4	14.8	36.3
33.1	34.1	11.5	50.5	24.5	51.5	20.8	37.5	23.0	14.6	34.4
33.1	34.8	12.0	49.6	21.7	------	24.2	------	22.7	16.0	34.1
33.3	34.6	11.2	48.7	22.8	------	22.8	------	23.4	15.9	-----
33.6	35.4	11.6	61.0	22.6	52.7	22.0	42.3	24.1	15.8	37.8
34.4	35.8	12.3	52.4	25.6	51.2	23.8	38.7	23.0	15.7	33.4
35.4	33.9	10.3	47.2	23.2	------	22.8	------	22.6	15.0	35.3
35.6	32.3	11.4	63.8	26.4	54.5	------	41.3	23.6	16.0	38.5
35.6	34.6	12.2	67.6	24.7	56.5	21.3	42.7	26.1	16.6	36.8
35.9	35.7	12.1	60.0	23.7	------	22.6	------	22.8	14.8	35.4
35.9	32.3	11.3	48.7	24.2	------	25.4	------	23.1	15.6	35.7
36.2	33.4	10.6	60.0	23.8	------	23.4	------	23.5	15.5	34.8
36.6	32.8	12.3	53.0	23.2	------	22.6	------	24.0	14.8	35.5
36.6	36.7	11.4	61.2	24.0	52.5	25.4	39.4	22.1	14.8	34.4
36.6	34.2	11.1	58.2	27.3	------	24.3	------	22.7	15.6	38.8
36.7	34.1	11.1	52.6	25.3	------	23.2	------	23.2	15.5	36.5
36.9	31.7	9.9	59.1	25.0	------	24.9	------	23.0	15.2	37.9
37.1	34.0	12.1	52.9	22.9	------	22.9	------	23.2	16.2	34.8
37.7	34.0	11.0	47.0	23.6	------	23.8	------	22.3	15.6	35.8
38.4	35.4	12.4	50.2	23.6	------	23.2	------	24.0	14.3	36.2
39.2	35.0	11.7	60.5	24.0	------	------	------	23.5	14.5	38.8
39.5	34.4	12.4	53.7	26.8	------	24.5	------	23.5	15.4	37.5
39.8	32.7	11.7	56.3	23.6	------	24.4	------	23.4	14.6	38.9
39.9	34.4	11.2	48.6	24.0	------	23.5	------	22.6	14.8	36.1
40.0	33.5	11.2	52.5	26.0	52.5	25.5	38.0	22.5	15.5	38.0
40.1	34.2	11.8	53.4	23.6	------	23.2	------	23.2	13.7	37.4
40.1	32.4	10.4	50.6	21.9	------	20.6	------	20.2	14.2	32.9
40.1	33.4	11.2	57.1	23.6	------	22.6	------	20.4	14.5	36.2
41.1	33.1	11.1	51.6	25.3	------	22.6	------	22.6	14.8	34.5
41.2	32.3	11.5	58.5	28.2	------	26.5	------	24.0	13.8	37.4
41.9	34.4	11.7	54.0	26.0	------	23.4	------	22.0	14.6	36.8
42.1	31.6	11.1	69.0	25.6	56.5	26.6	48.0	24.0	14.7	38.2
42.2	32.0	10.3	51.7	25.8	------	23.9	------	22.7	15.2	36.5
42.5	32.3	11.0	60.0	------	56.0	21.2	42.2	22.1	14.4	-----
42.6	35.2	12.0	58.3	27.0	53.5	25.6	40.5	24.2	18.1	39.4
42.9	33.6	11.7	54.9	25.2	51.3	23.4	40.0	23.1	------	36.8
42.9	34.8	11.7	54.9	25.7	------	24.0	------	22.8	15.2	37.5
43.9	34.4	11.8	54.5	27.2	------	24.2	------	23.0	13.7	36.9
44.2	34.8	11.5	51.5	24.6	------	25.1	------	22.3	14.5	37.8
44.8	33.2	10.8	57.4	25.9	------	23.7	------	20.3	14.7	35.9
44.8	33.2	11.4	53.2	27.0	------	25.5	------	23.2	14.5	37.7
44.9	34.4	11.8	57.0	26.6	53.7	25.4	42.6	23.2	15.4	37.4
44.9	31.7	9.8	56.9	------	53.8	------	------	20.7	13.8	34.7
46.4	31.1	10.4	57.9	25.7	52.1	25.5	42.9	20.5	13.8	34.9
46.6	30.7	10.9	49.6	32.4	------	28.4	------	24.9	13.7	41.6
46.6	31.8	10.5	67.8	22.5	------	22.3	------	20.2	15.2	33.9
48.3	35.6	12.2	57.0	27.4	54.0	26.2	42.3	24.2	15.5	38.7
48.8	34.6	11.5	66.5	30.6	------	27.3	------	22.3	15.2	38.3
49.0	32.9	11.0	52.1	23.3	------	23.4	------	23.1	13.9	36.3
51.0	32.0	10.8	60.8	29.4	55.0	22.6	44.5	26.1	12.2	38.4
51.0	32.4	11.6	55.5	25.8	------	26.9	------	20.8	15.1	35.1
51.5	33.8	11.7	53.8	30.2	------	27.4	------	23.1	15.7	39.2
52.0	31.9	11.0	52.1	28.1	52.3	25.8	40.8	22.1	14.6	36.5
52.0	32.9	11.5	52.9	28.8	------	23.9	------	23.3	14.2	38.1
55.0	33.3	10.7	53.4	27.1	------	24.2	------	22.4	14.0	35.8
55.5	33.2	10.6	60.0	29.0	55.1	25.0	43.0	23.4	15.0	37.5
56.0	31.6	10.7	61.6	31.5	54.6	27.0	41.5	23.4	14.1	38.4
57.0	30.9	11.2	55.2	26.7	55.0	25.1	41.5	20.7	14.7	36.1
57.0	33.0	10.2	55.3	29.6	------	24.8	------	23.2	14.7	37.9
59.0	34.3	10.8	51.9	27.5	------	25.4	------	------	14.1	36.4
59.5	32.5	11.4	75.4	36.4	59.2	30.4	48.7	21.3	14.5	38.8
63.5	30.9	10.1	66.5	33.4	55.0	26.2	45.0	23.5	13.7	40.5
64.5	31.5	11.9	56.6	31.4	54.6	------	41.7	23.6	14.6	40.9

APPENDIX TABLE 2.—*Measurements of selected body proportions for* Trachinotus *spp., expressed as percent of standard length*—Continued

Standard length (mm.)	Percent of standard length										
	Head length	Eye diameter	Body depth	Dorsal fin		Anal fin		Pectoral fin length	Pelvic-fin length	Caudal-fin lobe length
				Lobe length	Base length	Lobe length	Base length			
T. falcatus—Con.										
64.5	30.9	10.2	57.7	28.7	54.8	------	44.1	20.8	13.8	35.7
66.5	32.2	10.5	56.5	30.6	------	28.1	------	23.3	14.1	37.7
74.0	29.6	9.9	66.3	30.2	56.3	29.7	43.6	24.1	12.7	39.5
75.5	28.9	9.5	63.0	34.8	56.9	27.4	45.4	22.6	13.0	37.6
76.0	30.1	9.5	58.4	33.6	53.5	26.4	44.5	20.7	12.4	36.1
84.0	29.8	9.8	67.8	36.7	57.6	29.0	46.5	22.4	12.1	39.4
85.0	31.2	10.0	59.0	35.0	55.5	29.2	43.9	21.9	13.4	36.4
85.0	28.6	9.7	69.4	35.5	54.5	26.8	45.4	22.4	12.2	36.6
85.5	31.8	10.8	65.6	43.0	57.0	33.6	46.6	23.6	13.5	45.6
89.5	29.2	9.4	58.2	35.4	55.9	28.5	45.2	21.7	15.2	39.0
100.0	28.9	9.3	63.0	33.9	55.5	29.1	45.0	21.0	12.1	37.2
102.0	28.6	9.1	64.2	37.8	55.9	28.1	46.6	22.4	13.2	40.7
103.0	29.2	9.5	59.7	35.2	55.5	26.3	44.7	21.0	13.3	34.3
125.5	27.0	8.7	64.1	39.8	56.1	32.0	47.0	21.8	11.9	33.9
127.5	27.8	8.3	68.5	42.7	59.6	33.4	47.5	23.6	------	42.7
132.0	29.3	9.4	64.4	47.0	56.0	36.8	45.8	24.0	12.3	-----
133.5	30.4	8.7	63.6	44.2	56.5	35.7	45.0	22.6	12.5	44.2
136.5	30.1	8.8	68.0	42.5	57.9	32.2	47.6	21.9	12.5	41.0
154.5	26.9	8.5	63.0	32.4	57.0	33.6	46.3	21.4	11.7	43.4
172.0	25.2	8.3	62.0	------	58.1	33.7	46.0	20.6	12.0	44.8
174.0	26.8	7.9	63.8	46.0	56.0	37.4	44.2	21.7	10.7	44.3
182.0	25.7	7.5	61.0	44.0	57.8	35.3	45.6	21.0	11.0	42.9
216.5	26.5	7.9	57.3	47.0	55.5	30.0	46.1	21.9	10.5	45.5
T. glaucus:										
7.8	38.8	14.0	35.8	------	42.0	------	28.0	------	9.4	33.4
11.8	41.0	14.3	35.0	------	42.0	------	27.4	23.3	18.0	34.5
14.6	36.3	12.9	36.3	22.6	45.2	22.1	29.7	24.4	16.9	35.0
16.6	35.5	12.8	34.4	------	45.8	22.5	31.3	25.0	17.4	35.5
19.4	34.5	10.9	36.0	------	43.8	------	30.4	21.3	14.7	34.5
23.3	34.8	11.2	38.2	24.0	44.6	23.2	30.5	20.1	17.3	34.9
23.9	35.5	10.4	32.2	23.4	45.2	22.6	30.1	23.0	16.8	34.7
24.0	33.8	9.8	35.0	25.4	45.0	23.8	30.8	21.6	17.0	35.0
26.2	32.4	10.4	30.5	24.8	47.3	21.7	32.1	22.5	17.5	35.5
28.9	34.2	9.7	32.2	23.5	44.6	19.4	29.4	19.4	16.5	34.3
35.8	35.3	10.4	36.8	24.6	47.2	22.6	32.1	22.4	19.6	36.0
36.0	33.9	9.2	31.7	25.2	48.3	24.2	31.7	22.7	16.7	35.6
36.5	32.9	9.3	31.0	25.4	46.8	24.0	31.5	22.2	17.0	35.9
39.2	33.0	9.7	31.9	24.5	47.7	24.7	33.7	23.2	17.6	35.2
39.4	33.2	9.7	38.9	23.8	48.2	23.6	32.7	22.1	16.5	35.3
44.8	33.1	9.3	38.2	26.4	46.9	25.7	35.3	21.0	18.3	36.0
44.8	33.7	9.3	33.3	26.6	49.6	25.7	33.7	22.1	16.9	36.6
45.0	32.1	10.0	37.2	26.9	47.1	26.0	33.6	22.7	17.1	36.7

APPENDIX TABLE 2.—*Measurements of selected body proportions for* Trachinotus *spp., expressed as percent of standard length*—Continued

Standard length (mm.)	Percent of standard length									
	Head length	Eye diameter	Body depth	Dorsal fin		Anal fin		Pectoral fin length	Pelvic-fin length	Caudal-fin lobe length
				Lobe length	Base length	Lobe length	Base length			
T. glaucus—Con.										
46.5	32.1	9.0	34.2	27.6	46.5	24.8	33.3	22.4	16.5	35.7
47.1	30.8	9.4	38.0	25.9	49.0	25.7	32.1	23.6	------	36.3
47.2	31.8	9.0	36.4	25.3	48.7	23.3	33.7	22.0	16.5	35.0
47.8	32.2	9.6	36.4	25.6	47.1	25.1	32.8	22.0	16.9	35.4
48.2	32.2	9.1	39.2	29.5	49.4	26.0	33.4	21.6	16.8	35.4
48.2	32.0	8.8	36.5	26.2	49.4	27.4	32.2	22.4	16.3	35.3
48.5	32.4	9.0	36.1	23.5	48.7	21.9	34.4	22.9	17.7	37.0
50.5	34.0	9.1	35.1	27.0	48.5	23.6	35.0	21.0	16.1	35.6
52.0	33.5	9.1	38.1	25.4	49.4	24.2	36.5	23.3	17.3	39.0
61.0	33.3	8.9	40.3	25.6	49.0	23.3	35.6	22.0	17.1	37.1
63.0	31.1	8.1	41.3	26.5	50.5	27.0	35.9	22.2	17.5	-----
65.0	31.4	8.5	41.4	28.0	51.8	26.5	36.9	22.9	15.7	36.4
68.5	32.3	8.6	42.2	30.8	51.1	27.9	36.9	22.4	16.5	-----
70.0	32.3	8.7	41.3	27.2	49.4	25.8	35.9	20.6	16.3	37.0
71.5	29.5	8.0	42.0	29.5	49.7	29.5	37.8	21.3	18.4	38.2
72.0	30.7	8.5	40.0	29.9	49.6	28.4	35.4	20.7	15.6	38.0
75.0	31.0	8.9	41.8	33.2	50.8	32.4	36.4	22.3	16.4	38.7
76.5	30.6	8.8	39.9	31.9	50.3	29.7	37.1	21.8	14.8	39.8
80.0	31.0	8.0	40.5	34.2	50.0	30.0	38.3	21.3	15.7	40.2
80.0	29.6	8.4	39.4	31.4	50.5	27.0	36.6	20.4	15.9	36.5
81.0	33.4	9.9	39.5	33.5	48.6	30.5	34.3	22.5	15.8	42.8
86.0	29.4	8.7	41.2	32.4	50.5	27.2	38.6	21.4	17.2	38.0
86.5	30.6	8.4	44.6	------	51.2	30.3	38.6	22.3	16.2	39.7
88.0	28.9	8.1	39.7	27.8	49.8	27.0	38.4	20.9	16.5	37.2
89.0	27.2	7.6	42.0	33.6	51.9	29.9	39.2	22.5	16.9	39.5
94.5	32.3	9.4	45.5	------	50.3	31.1	34.6	22.8	15.1	43.4
94.5	32.0	8.9	42.8	------	48.7	30.4	37.6	22.1	14.5	41.0
96.0	32.7	9.2	42.1	41.8	50.8	31.3	37.0	22.2	14.9	-----
97.5	30.7	8.7	43.4	47.5	50.2	38.4	36.4	22.6	15.5	43.8
99.0	30.1	9.5	42.3	------	49.4	30.4	36.2	22.6	15.1	41.9
101.0	31.2	8.8	43.9	35.7	50.5	29.1	36.2	------	14.8	-----
102.0	30.5	8.0	44.7	34.4	50.5	28.9	37.1	21.6	14.7	40.1
110.0	30.7	8.6	45.0	------	51.8	40.5	37.0	21.4	14.6	42.8
116.5	28.5	8.4	47.2	50.6	53.2	45.5	40.4	21.7	14.2	44.6
124.0	28.4	8.3	48.4	64.5	53.2	50.4	40.3	21.7	14.8	47.3
128.0	27.9	8.7	46.9	------	51.2	------	38.5	21.3	14.5	-----
139.0	28.5	7.3	50.0	50.8	53.6	45.0	39.9	21.2	12.1	42.8
141.5	26.2	7.3	46.6	53.0	53.7	53.0	40.6	21.8	14.3	46.0
211.0	26.1	7.4	53.3	72.0	55.0	67.0	43.4	21.2	13.0	-----